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VAUGHAN (E. K.) & ROSENSTIEL (R. G.). **Diseases and Insect Pests of Cane Fruits in Oregon.**—*Bull. Ore. agric. Exp. Sta.* no. 418 (revd.), 58 pp., 27 figs. Corvallis, Ore., 1949.

SCHUH (J.) & MOTE (D. C.). **Insect Pests of Nursery and ornamental Trees and Shrubs in Oregon.**—*Op. cit.* no. 449, 164 pp., 83 figs., 51 refs. 1948.

The first of these bulletins is a revision of one already noticed [*R.A.E.*, A **34** 292] and includes a similar section on the appearance, bionomics and control of the insects and mites that attack raspberry, blackberry and related cane fruits in Oregon. The second contains similar information on the pests of nursery stock and ornamental trees and shrubs there, excluding those that infest only seeds, cones or fruits, with notes on the plants attacked and a general section on insecticides and their use.

FRANKLIN (H. J.). **Cranberry Insects in Massachusetts.**—*Bull. Mass. agric. Exp. Sta.* no. 445, 64 pp., 4 col. pls., 89 figs., refs. Amherst, Mass., 1948. **Parts II-VII.**—*Op. cit.* no. 445 (continued), 88 pp., 63 figs., refs. 1950.

The first four parts of this work comprise short accounts of the distribution, morphology, food-plants, bionomics and control of the insects that attack cranberry in Massachusetts, arranged according to the parts of the plant attacked. The fifth is a survey of the natural enemies of cranberry insects, showing their importance and the hosts attacked, and also pollinators, and the sixth deals with insecticides and apparatus for applying them in cranberry bogs. The last part contains suggestions for investigating the relation of the surroundings of the bogs to the insects in them. It is pointed out in the course of the work that the Jassid that has long been recorded as *Scleroracus* (*Euscelis*) *striatulus* (Fall.) in Canada and the United States [*cf. R.A.E.*, A **25** 777 ; **26** 508 ; etc.], which is a European species, has been shown by P. W. Oman to be *S.* (*Ophiola*) *vaccinii* (Van D.) [*cf.* **36** 100 ; **37** 477]. It is the principal vector of the virus disease known as cranberry false blossom [*cf.* **22** 71, etc.].

SMALL (T.). **Colorado Beetle in Jersey, 1948.**—*Agriculture* **56** no. 3 pp. 115–116, 3 refs. London, 1949.

SMALL (T.) & THOMAS (G. E.). **Colorado Beetle in Jersey : 1949 and 1950.**—*Op. cit.* **57** no. 12 pp. 582–586. London, 1951.

In 1948, only six adults of the Colorado beetle [*Leptinotarsa decemlineata* (Say)] were found to have survived in Jersey after the control measures carried out against the heavy and scattered invasion of 1947 [*cf. R.A.E.*, A **38** 469, etc.], but another heavy invasion from the continent occurred on the north and east coasts in May, during a period of strong north-east winds and high tides. Many thousands of adults were found on seaweed at the high-tide mark, in crevices in the sea walls and on rocks out of reach of the tides, and these were dusted with 5 per cent. DDT between 18th and 23rd May, after which very few living beetles could be found on the beaches. A first application was made before the seaweed was disturbed and a second immediately after it had been turned over gently to expose the beetles sheltering beneath ; a third application was made in some cases. The last living beetle was found on 10th June. Potatoes growing within a mile of the east and north coasts were given a special additional spray and inspected, and the usual spraying of all crops was carried out. Few beetles from the coast reached potato crops inland. Throughout the season only 89 living beetles were found on potato ; 70 discovered in late August on volunteer plants in a turnip crop had recently

emerged, and the crop was heavily dusted twice with 5 per cent. DDT, and carbon bisulphide was injected into the soil in August and November. Two beetles were found on a yacht from Granville.

In 1949, no survivors from 1948 were found, but a small invasion occurred on the east coast in June, when there was a north-east wind. The usual precautions of spraying the beaches and spraying and inspecting the crops were taken. In 1950, there were at least three invasions, in early and late May and early June, again during periods of strong east or north-east winds and high tides. They ceased when the wind moved to the west or south-west. Infested beaches were dusted with 5 per cent. DDT as before, and hand-collection was carried out when dusting was impracticable. The beaches were inspected daily, and the carting of seaweed to the fields was prohibited. In all, 14 colonies, of which three, though light, were scattered, were found in the fields between June and August, and inspection, spraying and soil injection were carried out as usual. Larvae were occasionally seen feeding on tomato and *Solanum nigrum*. In 1950, assistance was given in the spraying of potato crops in Brittany and Normandy, particularly in late summer, as it is the overwintered adults that reach the Channel Islands in May or June. Weekly reports on the incidence of the pest in these areas and observations on the spring emergence of the hibernating adults in the coastal districts of France were used in an attempt to forecast invasions. The principal district from which these originate is not known, but the Cotentin peninsula is considered the most likely.

GIMINGHAM (C. T.) & THOMAS (I.). **Colorado Beetle in England, 1947.**—*Agriculture* **55** no. 2 pp. 55–63, 2 pls., 1 fig., 2 maps, 2 refs. London, 1948. **Colorado Beetle in England, 1948.**—*Op. cit.* **56** no. 2 pp. 65–70, 1 map, 2 refs. 1949. **Colorado Beetle in England, 1949.**—*Op. cit.* **57** no. 3 pp. 134–137, 1 map. 1950.

THOMAS (I.) & DUNN (E.). **Colorado Beetle in England, 1950.**—*Op. cit.* **58** no. 3 pp. 135–139, 1 map, 1 ref. 1951.

These reports, like earlier ones already noticed [*cf.* *R.A.E.*, A **37** 317, etc.], contain records of the numbers and locations of single adults and breeding colonies of the Colorado beetle [*Leptinotarsa decemlineata* (Say)] found in England during the years under review, with accounts of the measures taken against them. The majority of the single beetles were associated with imported products, but interceptions on ships and in ports confirmed that beetles can arrive in cross-Channel boats of any type and with any kind of merchandise, and finds of beetles on or near the coasts of Kent and Sussex in June 1950 appeared to indicate a flight from the continent. The numbers reported were 224 in 1947 ; 38 on imported produce, 11 on docksides and beaches, 17 inland on crops and more than 279 intercepted on ships and two on aircraft in 1948 ; 27 with imported products and 17 on ships in 1949 ; and 170, including 54 with imported produce, 49 on ships, 3 on aircraft and 11 on docksides and beaches in 1950. Breeding colonies on potato were most numerous in Kent, but also occurred in many other southern and eastern and some midland counties ; there were 57 in 1947, 11 in 1948, none in 1949 and 29 in 1950. Most were small, and infestation rarely recurred where control measures had been carried out.

The careful examination of crops in areas in which infestation was suspected, hand-collection of all stages and injection of carbon bisulphide into the soil were continued each year [*cf.* **35** 311], and emergency spraying or dusting of potatoes in fields within about 0·5–1 mile of infestations and precautionary spraying or dusting in some other areas, such as those near the sites of breeding

colonies of the previous year, certain ports and the Thames estuary, were also carried out. Sprays of lead arsenate were applied in 1947–49, and dusts and sprays of DDT in all years.

HAWKINS (J.) & DEVITT (J. J.). **Forecasting Hatching Levels of the European Corn Borer.**—*J. econ. Ent.* **45** no. 2 pp. 203–209, 3 graphs, 8 refs. Menasha, Wis., 1952.

Since forecasts of hatching dates are useful for timing spray applications against the European corn borer [*Pyrausta nubilalis* (Hb.)] on maize, the relation between adult emergence in spring and the dates of hatching of the next generation was investigated in Maine in 1946–51. The dates of emergence of 0·05 or (in a second series) 5 per cent. of the moths in the six years are plotted on graphs against the periods in days between these dates and the dates of hatching of 5, 15, 50 and 90 per cent. of the eggs of the next generation, and other graphs relate the second series of periods to the sums of daily mean temperatures between 11th April and the dates of 5 per cent. emergence. Statistical analysis indicated that all three methods were significantly reliable for forecasts of 5 per cent. hatch, the first and third for 15 per cent. hatch and the first for 50 per cent. hatch. When the three methods were combined and the mean was used, the greatest errors between the forecast and actual dates of 5, 15, 50 and 90 per cent. hatch in any one year were 1·8, 3·3, 4·2 and 5·9 days, respectively.

KERR jr. (T. W.). **Further Investigations of Insecticides for Control of Insects attacking ornamental Trees and Shrubs.**—*J. econ. Ent.* **45** no. 2 pp. 209–212, 6 refs. Menasha, Wis., 1952.

During 1951, the effectiveness of several insecticides and the timing of spray applications were investigated in field tests against six insects found attacking ornamental trees and shrubs in Rhode Island [*cf. R.A.E.*, A **39** 314]. All spray quantities are given per 100 U.S. gals. water, and all chlorinated hydrocarbons were used as wettable powders.

Both nicotine sulphate and 25 per cent. lindane [at least 99 per cent. γ benzene hexachloride] were effective against *Mindarus abietinus* Koch on balsam fir [*Abies balsamea*] and Arizona fir [*A. arizonica*], one application of 1 U.S. pint of the former or 0·5 or 1 lb. of the latter in mid-May, when the length of new growth averaged 1·7 cm. per twig, giving more than 98 per cent. reduction of the Aphid in 6 days, as compared with no treatment. Single applications of 1 U.S. pint nicotine sulphate or 0·5 or 1 lb. 25 per cent. lindane gave 100, 91·3 and 98·4 per cent. control of *Chermes cooleyi* Gill. on Douglas fir [*Pseudotsuga taxifolia*] in six days, whereas 1–2 lb. 50 per cent. DDT was relatively ineffective. The sprays were applied soon after the middle of May when nearly all the eggs produced by the adult sistentes had hatched.

Complete control of larvae of *Nematus ventralis* Say on willow was given in three days by 0·5–2 lb. 50 per cent. DDT, 1–2 lb. 50 per cent. methoxy-DDT (methoxychlor) or 3 lb. lead arsenate with 1 lb. adhesive, applied on 26th June, and all but 0·5 lb. DDT prevented reinfestation for 27 days. On wild cherry and apple, 0·5 lb. 50 per cent. DDT or methoxy-DDT and 3 lb. lead arsenate with 6 lb. lime, applied on 7th or 8th May, all gave complete control of larvae of *Malacosoma americanum* (F.) in 14 days. The first two acted much more quickly than the third, killing most of the larvae within 48 hours.

One application of 1 lb. 50 per cent. DDT on 6th June and two of 1 U.S. pint nicotine sulphate on this date and 12 days later gave 99·6 and 96·3 per cent. control, respectively, of newly hatched female crawlers of *Unaspis euonymi* (Comst.) on *Euonymus fortunei minima*, whereas two applications of

1 lb. 25 per cent. lindane or 10 per cent. 1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene [dieldrin] caused increases in population. On privet (*Ligustrum vulgare*), 1 U.S. quart nicotine sulphate applied on 9th and 18th July and 1 U.S. pint and 1 U.S. quart applied on these dates and also on 30th July and 9th August gave 95·1, 89·3 and 96·2 per cent. control, respectively, of *Leucodiaspis* (*Leucaspis*) *japonica* (Ckll.) by November. Applications of 2 lb. 50 per cent. DDT on all four dates gave poor control.

HOPKINS (L.), NORTON (L. B.) & GYRISCO (G. G.). **Persistence of Insecticide Residues on Forage Crops.**—*J. econ. Ent.* **45** no. 2 pp. 213–218, 6 graphs, 6 refs. Menasha, Wis., 1952.

Experiments were carried out in New York in 1950 to assess the amounts of organic residue on forage crops after various dust treatments. Plots of lucerne were dusted with a hand fertiliser-spreader at 2 lb. actual toxicant per acre, once, twice or three times at weekly intervals, and samples of standing hay were taken at the time of each application and each week thereafter. Chemical analysis of the residues showed that more than 98 per cent. of the original deposits were lost 21 days after one application. Residues of parathion and aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] had disappeared almost entirely 21 and 28 days, respectively, after one application and these periods increased progressively by about an additional week after each additional application. BHC (benzene hexachloride), lindane [at least 99 per cent. γ BHC] and DDT residues became insignificant 37, 32 and 40 days after one application, 48, 45 and 52 days after two and 55, 50 and 60 days after three. Residues of technical DDT appeared to persist longer than those of the pure compound in some tests, but the results were not consistent. Residues of all materials but DDT were usually less than 2 parts per million after 30 days, even when three applications had been made. The rapid growth of lucerne and the occurrence of heavy rain during the growing season are important factors in residue loss, but the volatility of the insecticides themselves should not be overlooked in the final analysis.

TENHET (J. N.) & BARE (C. O.). **Lindane as an Insecticide to control Tobacco Moth and Cigarette Beetle.**—*J. econ. Ent.* **45** no. 2 pp. 218–222. Menasha, Wis., 1952.

The following is based on the authors' summary. Experiments were carried out in the United States in 1950 on the effectiveness of lindane [at least 99 per cent. γ benzene hexachloride] in oil as a contact insecticide against adults of *Ephestia elutella* (Hb.) and *Lasioderma serricorne* (F.) in tobacco warehouses. In laboratory tests, a space spray containing 0·25 per cent. lindane in a light volatile oil killed 100 per cent. of *E. elutella* when applied at a rate of 100 ml. per 1,000 cu. ft. and 2 and 3 per cent. sprays killed 84 and 95 per cent., respectively, of *L. serricorne*. In single tests in warehouses containing hogsheads, a space spray of 2·85 per cent. lindane in oil, applied at 100 ml. per 1,000 cu. ft., was about as effective against both species as one containing 0·89 per cent. pyrethrins. In three large-scale tests, thermal aerosols released from solutions of 2–2·5 per cent. lindane in oil were effective against both insects when used at 100 ml. per 1,000 cu. ft., and against *Ephestia* but not *Lasioderma* at 60 ml.

When flue-cured tobacco was exposed to repeated heavy applications of space sprays of lindane in oil, its aroma and smoking quality were slightly impaired, but the effect was not noticeable enough to be considered important, and when it was exposed to repeated applications of a thermal aerosol of lindane, chlordan and oil (2 : 3 : 95), the effect of this on the aroma was so

slight as to be considered negligible ; no effect on the smoking quality could be detected. Chemical analysis failed to show any appreciable difference in the organic-chlorine content of tobacco repeatedly exposed to space sprays of lindane and oil or to thermal aerosols of lindane, chlordan and oil and untreated tobacco.

LUCKMANN (W. H.) & DECKER (G. C.). **A Corn Plant Maturity Index for Use in European Corn Borer Ecological and Control Investigations.**—*J. econ. Ent.* **45** no. 2 pp. 226–232, 4 figs., 7 refs. Menasha, Wis., 1952.

The following is based largely on the authors' summary. A technique is described for calculating an index to show the maturity of a maize plant during the developmental period after tassel initiation. It involves comparing the height of the tassel and the height of the plant and expresses maturity as 100 times the ratio of the distance between the base of the plant and the tip of the tassel bud to the distance between the base of the plant and the tip of the longest leaf extended upwards ; this is termed the tassel-ratio index, and most varieties of sweet maize begin to show their tassels when it is about 55. Although this method of indicating plant maturity can be used from tassel initiation to the death of the plant, it is most useful during the period between tassel initiation and anthesis. Its advantages over other criteria, such as height of plant, number of days after planting, number of visible and developed leaves, and whorl stages, are discussed.

By the use of the tassel-ratio technique, it was found in Illinois that significant survival of larvae of *Pyrausta nubilalis* (Hb.) on sweet maize begins at an index of about 15–20 ; that survival is highest on maize that will begin to show tassels in 1–3 days ; that the plants are in the critical period for the survival of larvae during the 9–12 days before tasselling ; and that a single application of a DDT spray was most effectively made for control of the larvae when the plant had a tassel-ratio index of 46–49.

HETRICK (L. A.). **The comparative Toxicity of some organic Insecticides as Termite Soil Poisons.**—*J. econ. Ent.* **45** no. 2 pp. 235–237, 3 refs. Menasha, Wis., 1952.

Observations previously recorded on the effect of various organic compounds on workers of *Reticulitermes flavipes* (Koll.) [*R.A.E.*, A **38** 427] were continued for a further two years. The soil in the jars had not been disturbed since the preparation of the samples, but water was added before each test, and it was found that DDT and pentachlorophenol at 1 : 200, DDD (TDE) [dichlorodiphenyldichloroethane], sodium pentachlorophenate and methoxy-DDT (methoxychlor) at 1 : 1,000, toxaphene at 1 : 10,000, chlordan at 1 : 20,000 and γ BHC [benzene hexachloride] at 1 : 100,000 were still very effective at the end of five years. At comparable dilutions, methoxy-DDT acted more and DDD less rapidly than DDT, and γ BHC more rapidly than chlordan. Pentachlorophenol and sodium pentachlorophenate acted rapidly at the very high concentrations of 1 : 200 and 1 : 100–1 : 500, respectively. In similar tests begun at a later date, aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] and heptachlor [1(or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene] at 1 : 100,000 were still giving very rapid control after about two years.

WEAVER (C. R.). **Fall Applications of Insecticides to control Spittlebug Nymphs.** —*J. econ. Ent.* **45** no. 2 pp. 238–241, 2 graphs, 8 refs. Menasha, Wis., 1952.

In further investigations on the control of *Philaenus leucophthalmus* (L.) on leguminous forage crops in northern Ohio [*cf. R.A.E.*, A **39** 339, etc.], three applications of DDT dust (1 lb. actual toxicant per acre) to newly sown lucerne at fortnightly intervals from 31st July 1948 resulted in 70·6 per cent. control of nymphs on 17th May 1949 and increased the yield from 3,699 to 4,510 lb. baled hay per acre, and spraying red clover with DDT on 12th and 27th August caused similar reductions in infestation and increases in yield. DDT applied at 1 lb. and methoxy-DDT (methoxychlor) at 2 lb. in 100 U.S. gals. water per acre on 7th July 1949 were more effective against adults on lucerne grown for seed than similar sprays of 1·5 lb. toxaphene, 0·5 lb. γ BHC (benzene hexachloride), 1 lb. chlordan, 0·55 lb. heptachlor [1(or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene] or 0·53 lb. aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene]. Applications of 1 and 2 lb. DDT in 100 U.S. gals. water per acre to mixed lucerne and red clover on 19th August gave only 28·9 and 61·5 per cent. reduction in stems infested by nymphs the following May, whereas similar applications on 2nd September gave 73·9 and 93·1 per cent., which was adequate, and one of 0·2 lb. γ BHC per acre on 15th May gave 99·5 per cent., as compared with no treatment. One application of 1 lb. DDT per acre to lucerne on 8th August and two on 8th and 30th August gave 19·8 and 71·4 per cent. reduction in infested stems, respectively, and increased the yield of hay per acre from 4,080 to 4,930 and 5,655 lb. Similar increases in yield were obtained on plots of birdsfoot trefoil [*Lotus corniculatus*]. DDT and methoxy-DDT applied to lucerne at 1 and 2 lb. per acre, respectively, on 19th September gave excellent control of adults, but poor reduction of stems infested by nymphs the next spring, as about half the eggs had already been deposited.

Applications of 1·5 lb. DDT as a wettable powder in 100 U.S. gals. water per acre at 150 lb. pressure and as a liquid formulation at 9 U.S. gals. per acre and 30 lb. pressure on 3rd September 1950 both gave significant reductions in the nymphal population (72–82 per cent.) on lucerne in the following May, with no significant difference between them. Sprays of 1·5 lb. DDT in 100 U.S. gals. per acre on lucerne gave immediate reductions of the adults but permitted reinfestation in two weeks when applied on 12th August, and good control with no reinfestation when applied on 2nd or 13th September. When 1, 1·5 or 2 lb. DDT in 100 U.S. gals. per acre was applied on 2nd September, the percentage reductions in the numbers of nymphs per stem and (in brackets) in infested stems on 15th May were 77·9 (49), 83·3 (61·8) and 90·7 (72·7) and those in the numbers of adults taken per sweep on 10th June, when emergence was at a peak, were 80·5, 82·7 and 87·8, respectively, as compared with no treatment. It is concluded that the application of 1–2 lb. DDT per acre during the first week of September was the most effective control method tested, and that estimating control from the percentages of stems infested by nymphs gives a very conservative result [*cf.* **39** 186].

STEINER (L. F.). **Methyl Eugenol as an Attractant for Oriental Fruit Fly.**—*J. econ. Ent.* **45** no. 2 pp. 241–248, 2 refs. Menasha, Wis., 1952.

The following is based partly on the author's summary. Tests of more than 60 attractants and with several types of traps in Hawaii showed that methyl eugenol is one of the most effective baits for males of *Dacus ferrugineus dorsalis* Hend. [*cf. R.A.E.*, A **39** 176]. Methyl iso-eugenol, iso-eugenol and Ceylon citronella oil were attractive, but much less so than methyl eugenol, and most

of the other materials were ineffective. Emulsions of methyl eugenol or citronella oil were very attractive when first exposed, but absorption of the aromatics by large catches of flies or overflowing caused by rain resulted in a rapid loss of effectiveness. Methyl eugenol was most effective in open bottles when a piece of porous fibreboard or similar material was fixed at the bottom and impregnated with the attractant before water was added to fill the trap, and in these or in invaginated glass traps in which dental rolls impregnated with the attractant were protected from fly feeding, 1 ml. methyl eugenol per trap remained highly effective for a month or longer. A few drops poured on to porous lava rocks exposed to the weather remained attractive for 10–16 weeks. There was strong evidence that the males could be attracted for half a mile or more against a wind blowing at 8 miles per hour in 15 or more minutes.

A mixture of 2 ml. methyl eugenol and 2 gm. 25 per cent. parathion wettable powder was found to be a very effective poison bait when sprayed or painted on the inner surfaces of a box-type trap $3 \times 12 \times 16$ ins. in size having the upper part of one side replaced by 4-mesh hardware cloth. The methyl eugenol needed renewing frequently as it was consumed by the fruit-flies, but not the parathion, and flies that consumed methyl eugenol and died in the bottom of the trap were attractive to living fruit-flies. In a test of the effectiveness of such traps in destroying the males before they fertilise the females, 45 were set up in January 1950 round the 4-mile perimeter of a pine-apple field. They were painted inside with a parathion slurry at intervals of 6–8 weeks and sprayed weekly with 12 ml. 33 or (later) 66 per cent. methyl-eugenol emulsion. A substantial reduction in the male population over an area of at least 4 sq. miles was obtained, and in the following September, the lowest infestation in guavas (4·2 larvae per lb. fruit) in gulches adjacent to the field occurred in one near the centre of the area affected by the bait, whereas the infestations in four surrounding gulches were 31·6–39·6 larvae per lb.

SNAPP (O. I.). **Plum Curculio Control on Peach in 1951.**—*J. econ. Ent.* **45** no. 2 pp. 249-251, 4 refs. Menasha, Wis., 1952.

Tests of organic insecticides for the control of *Conotrachelus nenuphar* (Hbst.) on peach in Georgia [*cf. R.A.E.*, A **39** 380, etc.] were continued in 1951. All materials except Metacide (a liquid product containing 30 per cent. of a 1 : 4 mixture of parathion and its methyl homologue) were used as wettable powders, wettable sulphur was included as a fungicide in some applications, and a mixture of zinc sulphate and lime was used as a safener with lead arsenate. All spray quantities are given per 100 U.S. gals. Most of the insecticides were applied at petal-fall, shuck-off, two weeks after shuck-off and four weeks before harvest, but lead arsenate was applied only at petal-fall, shuck-off and four weeks before harvest, and parathion was also applied on the first three dates and five and three weeks before harvest.

In a large-plot test in a lightly infested orchard, 1·5 lb. 15 per cent. parathion (5 applications), and 2 lb. 25 per cent. EPN (O-ethyl O-p-nitrophenyl benzene-thiophosphonate), dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] or aldrin [1,2,3,4,10,10-hexa-chloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] resulted in 0–0·6 per cent. infested fruits at harvest, and 3 lb. 15 per cent. parathion (4 applications), 2 lb. 50 per cent. methoxy-DDT (methoxychlor) and 2 lb. lead arsenate in 1·7, 3·3 and 4·2 per cent. ; lead arsenate resulted in 25·1 per cent. infested dropped fruits between 25th April and 4th May, and the other treat-ments in 0–3 per cent.

In a small-plot test under conditions of excessive infestation (73·4 per cent. infested fruits on untreated trees at harvest), 4 or 5 applications of 1·5 lb. 15 per cent. parathion, 4 of 3 lb. 15 per cent. parathion, 8 fl. oz. Metacide,

or 2 lb. 25 per cent. EPN, malathon (O,O-dimethyl dithiophosphate of diethyl mercaptosuccinate [also known as S-(1,2-dicarbethoxyethyl) O,O-dimethyl dithiophosphate]), aldrin or Compound 1189 (an oxygenated dimer of hexachlorocyclopentadiene) or 2 lb. 50 per cent. methoxy-DDT and three of 2 lb. lead arsenate gave 45·6–77·7 per cent. infested fruits at harvest, probably without significant differences between them, whereas four of 2 lb. 25 per cent. dieldrin resulted in only 7·4 per cent. infested fruits. Omission of the petal-fall spray from the amplified parathion schedule had little effect.

Analysis of residues on the fruits at harvest showed 0·1 part per million or less for parathion, Metacide and malathon, 0·3 p.p.m. or less for EPN and 2·6 p.p.m. or less organic chlorine for aldrin, dieldrin, methoxy-DDT and Compound 1189. None of the insecticides affected the flavour, and none but lead arsenate caused any plant injury.

Cage tests indicated that Potasan (which contains 4-methylumbelliferone O,O-diethyl thiophosphate) was effective against the overwintered and newly emerged first-generation adults but soon lost its toxicity. CS-728 (50 per cent. of a chlorinated product of 1-p-chlorophenyl-1-phenyl-2-nitrobutane) at 2 lb. showed promise against the adults and had fairly prolonged toxicity. Compound 269 (an experimental mixture containing a stereoisomer of dieldrin) killed all first-generation adults within four days when used at 4 lb. 10 per cent. wettable powder but was not very persistent, Compound 711 (a similar mixture containing a stereoisomer of aldrin) was not very effective, and DDD (TDE) [dichlorodiphenyldichloroethane] was comparatively ineffective.

POLIVKA (J. B.). **Field Tests of Insecticides for Control of Japanese Beetle Larvae.**—*J. econ. Ent.* **45** no. 2 pp. 251–254, 3 refs. Menasha, Wis., 1952.

In this progress report on long-term field tests in Ohio, the author shows that DDT, applied to turf in October 1945 at 37·5, 25 and 12·5 lb. actual compound per acre in milorganite [*R.A.E.*, A **38** 81], was still giving highly significant control of larvae of *Popillia japonica* Newm. in October 1951 at the highest rate but began to show some decline in efficiency in 1950 at the other two, though control was still significant. Lead arsenate at 435 lb. per acre began a gradual decline in efficiency in 1948 and was useless by 1951. Chlordan, applied in an emulsion at 5–25 lb. actual compound per acre in September 1946, reduced the population significantly in a month and was still highly effective in 1951, whereas it was less effective at 1 lb. per acre and showed a somewhat rapid decline in 1951. DDT and lead arsenate, applied at 25 and 435 lb. per acre in milorganite in September 1946, were both highly effective in 1950 and 1951, though the lead arsenate had failed to prevent infestation in May 1947. Lead arsenate applied at 435, 870 and 1,305 lb. per acre in October 1947 was very effective until 1951, when it showed signs of decline, particularly at the lowest concentration. Lead arsenate applied at 435 lb. and chlordan at 5–25 lb. per acre in April 1948 gave highly significant control in October 1948 and throughout 1950 and 1951 ; DDT at 12·5 and 25 lb. was less effective on the first date, for unknown reasons, but highly effective in 1950 and 1951. Heptachlor [1 (or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene] applied at 5–20 lb. per acre in June 1949 [**39** 21] was still giving complete control in October 1951, but the 1 lb. dosage gave variable and less satisfactory results.

BORDEN (A. D.), MADSEN (H. F.) & RETAN (A. H.). **A Stink Bug, *Euschistus conspersus*, destructive to deciduous Fruits in California.**—*J. econ. Ent.* **45** no. 2 pp. 254–257, 3 figs., 6 refs. Menasha, Wis., 1952.

Euschistus conspersus Uhl., which had not previously been known as a pest of deciduous fruits, caused serious injury to pears in California in 1950

and 1951, and also damaged apples, apricots, figs, plums and peaches planted in infested orchards. Observations on the bionomics of this Pentatomid in the Sierra foothills showed that the adults hibernate in the orchards under weeds or débris from November until the end of March, begin feeding on the cover crop in early April and oviposit soon after on the undersides of the leaves or on weeds and other green plants, sometimes outside the orchards. Some oviposition occurred on pear leaves. The eggs were deposited in masses of 7–20 or more and hatched in 7–30 days. The nymphs appeared not to feed during the first instar. In the later instars, they fed on succulent weeds, but could not develop on pear leaves. Adults of the first generation emerged in mid-June, 67–79 days after the eggs had hatched, and fed on the fruits, causing severe damage, and on the cover crop. Those that had developed outside the orchards migrated into them as the other food-plants dried up. They laid eggs on any smooth surface, and the nymphs hatched in 5–9 days and fed mainly on succulent plants, though they occasionally attacked pear fruits during the fifth instar. The nymphal stage lasted 40–65 days, and the adults hibernated. The adults of this generation caused very little damage, either in autumn or in spring. There was only one generation a year in cooler parts of the State.

The damage caused to the fruits by the first-generation adults is described ; in some heavily infested areas, the two outermost rows of orchards showed 90 per cent. of fruits damaged by adults migrating from adjoining weedy areas, while the inner rows had 10–50 per cent. In laboratory feeding tests, the adults fed on many fruits and vegetables ; tomatos were much injured in one area [*R.A.E.*, A **40** 178]. The eggs are parasitised by four probably undescribed Scelionids belonging to the genera *Trissolcus*, *Telenomus* and *Hadronotus*. The degree of parasitism was low in the first generation, but much higher in the second, though insufficient to give economic control. A Reduviid was observed attacking one of the adult bugs on one occasion.

In tests, lindane [at least 99 per cent. γ benzene hexachloride] and 25 per cent. parathion at 1 lb. and dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] at 0·5 lb. per 100 U.S. gals. gave more than 95 per cent. control when applied to the cover crop at a pressure of 350 lb. per sq. in. in early spring or late autumn, and 4 lb. 50 per cent. DDT per 100 U.S. gals. gave a high kill in early spring but proved inadequate in summer and autumn. Parathion sprays against adults migrating into the orchards reduced fruit damage, but were too temporary in effect to give efficient control. Chemical control is apparently impossible without eradication of food-plants, and clean cultivation within the orchards, particularly when the eggs are hatching, and food-plant eradication in adjoining weedy areas throughout the fruit season are probably the most practical measures. Reduction of the adults by ground applications of insecticides in early spring as they leave their hibernation quarters and after harvest before they enter them should prove beneficial.

Richardson (B. H.) & Wene (G. P.). **Control of Onion Thrips in Texas.**—*J. econ. Ent.* **45** no. 2 pp. 258–262, 15 refs. Menasha, Wis., 1952.

Thrips tabaci Lind. is a serious pest of onions in the Rio Grande Valley of Texas, and as insecticides are usually applied against it only when injurious infestations have developed, a material that will reach its maximum effectiveness in 24 hours and exert prolonged control is required. Tests were carried out in two areas in 1946–51, the first on cabbage and the remainder on onion. Treatments were applied once unless otherwise indicated, dusts with rotary hand dusters at about 18 lb. per acre and sprays with a small garden sprayer at 50 or 100 U.S. gals. per acre.

In a comparison of dusts in 1946, 0·5 per cent. γ BHC (benzene hexachloride) gave 99 per cent. reduction in population in one day and 96 per cent. after three, as compared with no treatment. whereas 5 per cent. DDT was slower and less effective ; a combination of 0·5 per cent. γ BHC with 2·5 per cent. DDT gave at least 99 per cent. reduction for three days. In 1948, a dust containing 5 per cent. DDT and 50 per cent. sulphur gave 93 per cent. reduction after four days and 74 per cent. after eight, and the corresponding percentages were 89 and 83 for 1 per cent. parathion and 73 and 52 for 0·25 per cent. ; 5 or 10 per cent. toxaphene with sulphur was much less effective. In 1950, when four dust applications were made at intervals of ten days, 5 per cent. heptachlor [1 (or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene], 2·5 per cent. dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] and 2·5 per cent. aldrin [1,2,3,4,10,10 - hexachloro - 1,4,4a,5,8,8a - hexahydro - 1,4,5,8 - diendo - methanonaphthalene] were more effective than a mixture of 1 per cent. γ BHC and 5 per cent. DDT selected as the standard ; 1 per cent. parathion was more effective immediately but less so after a week than the standard, and 20 per cent. toxaphene was inferior to it immediately but better after 7–8 days. Lindane [at least 99 per cent. γ BHC] and γ BHC at 3 per cent. were almost as good as the standard just after treatment but much less toxic after a week, and 1 per cent. dieldrin was less effective than 2·5 per cent. The addition of 3 per cent. of an adhesive maintained the effectiveness of 5 per cent. DDT for a week and retarded the decline in that of BHC ; it was more effective with 0·5 than with 1 per cent. γ BHC. Mixtures of DDT and BHC were not improved by 3 per cent. of the adhesive, but 5 per cent. was beneficial in a further test. A different adhesive increased the percentage reduction given by a spray of 0·25 lb. DDT per 100 U.S. gals. water after a week from 48 to 57, but two others decreased it. In a further test, the addition of 50 per cent. sulphur greatly increased the effectiveness of 10 per cent. toxaphene, slightly increased that of the standard mixture of BHC and DDT and decreased that of a mixture of 5 per cent. chlordan with 5 per cent. DDT.

In 1951, the addition of 5 per cent. chlordan improved a dust of 1 per cent. γ BHC, and the mixture was superior to the standard with sulphur, whereas 5 per cent. chlordan with 5 per cent. DDT was inferior to it. Sulphur improved the efficiency of DDT after both two and eight days. A dust of 1 per cent. parathion was quite effective after two days but useless after eight. When dusts were applied twice at an interval of ten days, the percentage reductions after one and seven days were 81 and 78 for 1 per cent. parathion, 79 and 62 for 1 per cent. EPN (ethyl p-nitrophenyl benzenethiophosphonate), 87 and 74 for 2 per cent. EPN, 85 and 71 for 1 per cent. EPN with 95 per cent. sulphur, 74 and 33 for 2 per cent. 4-methylumbelliferone O,O-diethyl thiophosphate (Potasan), 83 and 73 for 1·5 per cent. of a mixture of parathion and its methyl analogue (Metacide), and 91 and 82 for the standard dust. In sprays in which the ingredients were applied in about 50 U.S. gals. water per acre, 0·5 lb. heptachlor was the most effective (95 and 89 per cent. reduction after four and eight days), and 1 lb. toxaphene, a mixture of 0·67 lb. toxaphene and 0·33 lb. DDT, 0·5 lb. aldrin and 0·25 lb. dieldrin gave good commercial control (71–88 and 65–73 per cent. reduction after four and eight days). Dieldrin at 0·125 lb., aldrin at 0·25 lb., EPN at 0·15 lb. and parathion at 0·1 lb. were less effective.

FRICK (K. E.). **Determining Emergence of the Cherry Fruit Fly with Ammonium Carbonate Bait Traps.**—*J. econ. Ent.* **45** no. 2 pp. 262–263, 3 refs. Menasha, Wis., 1952.

Since knowledge of the earliest date of adult emergence is necessary for successful control of *Rhagoletis cingulata* (Lw.) on cherry, tests were made in

Washington State in 1949 and 1950 of the effectiveness of dry-bait traps, consisting of waxed cartons, coated on the inside with adhesive and containing powdered ammonium carbonate as the attractant [*cf.* *R.A.E.*, A **37** 342]. When baited and unbaited traps and boards coated with adhesive were suspended in the trees, the first caught about 50 times as many adults as the others. Adults were found in bait-traps 3–19 days before the first examples emerged in cages set over the soil in a heavily infested orchard in 1949 and up to 4 weeks before in 1950. As emergence may have begun 1–2 days before the first individuals are caught in the traps, control measures should be instituted in each district as soon as the first fly is taken there.

LINDQUIST (A. W.). **Radioactive Materials in entomological Research.**—*J. econ. Ent.* **45** no. 2 pp. 264–270, 25 refs. Menasha, Wis., 1952.

The author briefly outlines the principles of radioactivity, describes the four types of radiation (α-particles, β-particles, γ-rays and X-rays) most frequently encountered in biological and medical research, indicates the extent and variety of the uses of radioactive isotopes, defines the terms commonly employed in work on radioactive materials, and reviews their uses in entomological research.

Radioactive isotopes are used as tracers in studies of the distribution of various chemicals in plants and animals [*cf.* *R.A.E.*, A **38** 159; **39** 13, 428; **40** 31], which may include investigations on the penetration of insect cuticle, the ways in which insecticides enter insects and are distributed in and eliminated by them, and the effects of sublethal doses. Tests on house-flies (*Musca domestica* L.) have shown that absorption or penetration of radioactive DDT continued after the treated insects had died, indicating that the amount absorbed should be measured soon after death to show the lethal dosage. Radioisotopes might also be used to study the physical properties of emulsions and suspensions and the distribution of sprays or dusts applied with various types of equipment. Radioactive materials are used in ecological investigations to mark insects, which are liberated and later detected with suitable apparatus [*cf.* **38** 82], and the possibility of controlling an insect by the release of males sterilised by X-rays [B **40** 43] has been suggested.

Suggestions on the initiation of studies with radioactive materials include information on the types of equipment for detecting radioactivity that are most suitable for biological research.

JEPPSON (L. R.). **Field Studies with new Acaricides to control Citrus Bud Mite.**—*J. econ. Ent.* **45** no. 2 pp. 271–273, 2 refs. Menasha, Wis., 1952.

Sprays of petroleum oil are effective and widely used against *Aceria sheldoni* (Ewing) on *Citrus* in California [*cf.* *R.A.E.*, A **30** 429], but as their application is sometimes inadvisable, substitutes for them were sought. In a preliminary test of 44 materials on lemon, the dicyclohexylamine salt of 4,6-dinitro-o-sec.-butylphenol (DN-211) as a wettable powder, emulsion sprays of di-2-ethylhexyl phthalate, emulsified solutions of DDT in kerosene and both emulsion and wettable-powder sprays of chlordan and Aramite (2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite) gave good control, based on the percentage of infested buds, whereas sprays of several other materials commonly used as insecticides or acaricides, including EPN (ethyl p-nitrophenyl benzenethiophosphonate), schradan (octamethyl pyrophosphoramide) and parathion, gave only fair control, and benzene hexachloride, aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] and toxaphene gave poor control or none.

When the five promising materials and parathion were compared with a standard 1·75 per cent. medium-grade petroleum-oil spray under a variety of conditions [*cf.* also **38** 413], 0·2 lb. DN-211 per 100 U.S. gals. was generally less effective than the standard spray, but gave adequate control often enough to warrant its use under certain field conditions ; some injury to young lemon foliage occurred when treatment was followed by hot weather. Di-2-ethylhexyl phthalate was as effective as the standard at 1 quart per 100 gals. and usually more so at 2 quarts, but caused as much damage to trees and fruit as did the oil spray and did not control *Saissetia oleae* (Bern.) or *Aonidiella aurantii* (Mask.) so effectively. DDT at 1–2 lb. and chlordan at 1 lb. per 100 U.S. gals. in emulsified kerosene gave effective control, but resulted in an increase of *Paratetranychus citri* (McG.). Parathion was relatively ineffective at 0·5–1 lb. per 100 U.S. gals. as a wettable powder, but when it is applied for the control of *A. aurantii*, an initial and temporary reduction of *Aceria* populations may occur. Aramite, at 0·25–0·5 lb. per 100 U.S. gals. in a wettable-powder or emulsion spray, though less effective than oil against *A. sheldoni*, was sufficiently effective to be used as a supplement to petroleum oil in view of its value against *P. citri*. It appears to be the best of the materials tested and has been used extensively for commercial control of both mites.

CARTER (Walter). **Recent Developments in Oriental Fruit Fly Research.**—*J. econ. Ent.* **45** no. 2 pp. 274–279, 1 ref. Menasha, Wis., 1952.

This paper comprises a review of the results achieved during the second year of intensive work on the control of *Dacus ferrugineus dorsalis* Hend. in Hawaii, the prevention of the spread of that fruit-fly to the continental United States and the elaboration of measures to combat it there should spread actually occur [*cf. R.A.E.*, A **39** 175], and of subsidiary observations on *D. cucurbitae* Coq. and *Ceratitis capitata* (Wied.). Fruit-fly puparia were received in Hawaii from many tropical areas, and since the work began, 47 species of Opiines and 22 other species of parasites were reared from them. The search for parasites was continuing in Siam, North Borneo, Brazil and West Africa. Four species of *Opius* have become established on *D. f. dorsalis* in the field in Hawaii [*cf.* **40** 173, etc.], and it was found that the parasites of this genus that attack *D. f. dorsalis* will also attack *C. capitata*, though not *D. cucurbitae*. An unidentified species of *Opius* from North Borneo proved an effective parasite of *D. cucurbitae* in the laboratory and was released in large numbers, and *O. watersi* Fullaway, which was reared from cucurbits in India [*cf.* **40** 173], was recovered from *D. cucurbitae* in the field. Methods for the mass-rearing of parasites have been developed. The population of *D. f. dorsalis* had begun to decline before the liberation of parasites, and *O. longicaudatus* (Ashm.), *O. oophilus* Fullaway and *Opius* sp. have now so reduced infestation in guava that uninfested fruits are common, and heavily infested ones rare. Nevertheless, the host-fruit range is so large that biological control still requires supplementing by chemical measures. Biological control of guava fruiting seems desirable, to prevent the encroachment of the tree on range land and to reduce the potential fruit-fly infestation. Although the likelihood of the spread of *D. f. dorsalis* to the United States has been reduced, rigid adherence to quarantine requirements is still necessary. The shipping of commodities has been facilitated by the discovery that ethylene dibromide is a safe and effective fumigant at extremely low concentrations [*cf.* **40** 74].

Investigations are being carried out on the environmental requirements of all three fruit-flies [*cf.* **40** 118]. It is known that temperatures during the mating and preoviposition periods are important, and from cage tests described, in which continental conditions are reproduced, it is hoped to prepare maps showing the probable and possible seasonal distribution of *D. f. dorsalis* if it

reached the United States. Traps treated with methyl eugenol and parathion [*cf.* **40** 231] have proved effective against males of *D. f. dorsalis* and can be used to establish the extent of an infested area, to estimate current populations and possibly for control. Effective soil insecticides and sprays to leave toxic residues have also been found. Parathion, dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a - octahydro - 1,4,5,8 - diendomethanonaphthalene] and aldrin [1,2,3,4,10,10 - hexachloro - 1,4,4a,5,8,8a - hexahydro - 1,4,5,8 - diendomethano - naphthalene] act as contact insecticides and also as fumigants for several days after application, and parathion is effective in a bait-spray with protein hydrolysate and sugar.

Investigations on control of a large but relatively isolated infestation by *D. f. dorsalis* on guava and other fruits on the island of Lanai, in which insecticides were applied from aeroplanes and by fog machines, showed that all treatments tested drastically reduced the population, but that a minor infestation by *C. capitata* developed subsequently. Treatment with a combination of DDT and parathion might control both species. Chemical defoliation of the plants, which almost eliminated the next fruit crop with no permanent damage to the trees, also showed promise against *D. f. dorsalis*.

JOHNSON (G. A.), FLETCHER (J. H.), NOLAN (K. G.) & CASSADAY (J. T.). **Decreased Toxicity and Cholinesterase Inhibition in a new Series of Dithiophosphates.**—*J. econ. Ent.* **45** no. 2 pp. 279–283, 5 refs. Menasha, Wis., 1952.

Investigations on the relation between the cholinesterase inhibition *in vitro* and toxicity *in vivo* to insects and mice of insecticidal organic compounds containing the phosphoryl or thiophosphoryl group [*cf. R.A.E.*, A **39** 174, etc.] have indicated that the toxicity of such compounds depends on a chemical mediator (such as acetylcholine), an enzyme (such as cholinesterase), and the movement of an anti-enzyme (such as an insecticide) to a susceptible part of the organism. Attempts to find organic phosphorus compounds possessing specific toxicity to insects resulted in the discovery of a series of dithiophosphate esters, the S-(1,2-dicarbalkoxyethyl) O,O-dialkyl dithiophosphates, and the results are given of preliminary tests with compounds of this series, in which technical materials probably containing at least 70 per cent. of the pure compounds were used.

The esters were formulated as 25 per cent. wettable powders in clay, and then were tested in a settling tower as suspensions at various concentrations against *Aphis fabae* Scop. (*rumicis*, auct.) on nasturtium and adults of *Tribolium confusum* Duv. in petri dishes, or further diluted with talc and tested as uniform dust deposits applied in a dusting tower against adults of *T. confusum*, *Oncopeltus fasciatus* (Dall.) and *Blattella germanica* (L.). Acute oral toxicity to male albino mice was determined independently, and the median lethal doses in mg. per kg. were found to be 250 for S-(1,2-dicarbethoxyethyl) O,O-diethyl dithiophosphate (Compound 3975), 48 for S-(1,2-dicarbomethoxyethyl) O,O-diethyl dithiophosphate (Compound 4018), 930 for malathon (S-(1,2-dicarbethoxyethyl) O,O-dimethyl dithiophosphate) and 130 for S-(1,2-dicarbomethoxyethyl) O,O-dimethyl dithiophosphate (Compound 4075) as compared with 9·7 for parathion. The toxicities of malathon and Compounds 3975, 4018 and 4075 were 25, 11, 45 and 25 per cent. of that of parathion against *A. fabae*, 25, 6, 28 and 32 per cent. of it against *T. confusum* in the dusting test, 7, 10, 17 and 5 per cent. against *B. germanica* and 74, 76, 65 and 6 per cent. against *O. fasciatus*, and those of malathon and Compounds 4018, and 4075 in sprays against *T. confusum* were 24, 29 and 34 per cent. of it, respectively.

It was evident that there is no direct correlation between toxicity to mice and insecticidal activity and that malathon is a promising insecticide with relatively low toxicity to mammals. Investigations by R. L. Metcalf [*cf.* **38** 317] showed that the inhibitory action of malathon on brain cholinesterase of honey bees, house-flies [*Musca domestica* L.] and mice was 6·67, 128·6 and 1·67 per cent. of that of parathion, the ratio of the molar concentrations of malathon and parathion required for 50 per cent. inhibition of mouse-brain cholinesterase being 60 : 1 and that of the molar concentrations providing the median lethal dosages for mice about 85 : 1.

Very preliminary experiments with pure malathon indicated that its toxicity was greater to *T. confusum* but considerably less to mice than that of the technical material.

Lienk (S. E.), Chapman (P. J.) & Myburgh (A.). **Evaluation of Acaricides against three Species of Orchard Mites.**—*J. econ. Ent.* **45** no. 2 pp. 292–297, 3 refs. Menasha, Wis., 1952.

Experiments were continued in 1951 on acaricides for the control of *Paratetranychus pilosus* (C. & F.), *Tetranychus bimaculatus* Harvey and *Bryobia praetiosa* Koch on apple in New York. All spray quantities are given per 100 U.S. gals. As contrasted with 1950 [*cf. R.A.E.*, A **39** 333], when hatching was later, 8 fl. oz. 20 per cent. TEPP (tetraethyl pyrophosphate) was more effective against the winter eggs of *P. pilosus* and the immature mites when applied at the pink stage (12th May), at which it gave as good early-season control as 2 per cent. oil at the delayed-dormant stage, than at the calyx stage (24th May), and the same was true for 1 lb. 15 per cent. wettable parathion and 1·5 lb. 50 per cent. wettable p-chlorophenyl p-chlorobenzenesulphonate (Ovotran), both of which showed more persistent action than TEPP, and also for 1·5 lb. 15 per cent. wettable 2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite (Aramite), which was inferior to it. EPN (ethyl p-nitrophenyl benzenethiophosphonate), applied at 0·5 lb. 25 per cent. wettable powder at the pink stage, also showed promise and was more persistent than TEPP. Sprays of the systemic material, Systox (32 per cent. trialkyl thiophosphate [O-(2-(ethylmercapto)ethyl) O,O-diethyl thiophosphate]) at 8 fl. oz. were quite as effective as petroleum oil throughout the season, whether applied at the delayed dormant stage (30th April) or the pink or calyx stage, but did not control *P. pilosus* on the trees when applied to the ground cover only on 29th May, and gave only slight control on the unsprayed portions of partly sprayed trees, though re-establishment of the mites on the sprayed portions was prevented.

In tests against summer populations, applications on 3rd July of 0·5 lb. 25 per cent. EPN, 1 lb. 15 per cent. parathion, 1·5 lb. 50 per cent. Ovotran, 2 lb. 25 per cent. wettable malathon (S-(1,2-dicarbethoxyethyl) O,O-dimethyl dithiophosphate), 8 fl. oz. Systox, 12 fl. oz. 50 per cent. malathon emulsion concentrate and 24 fl. oz. 50 per cent. 2,4-dichlorophenyl benzenesulphonate emulsion concentrate, all gave good control of *P. pilosus*, and the same quantities of EPN, parathion, malathon emulsion concentrate and 2,4-dichlorophenyl benzenesulphonate, 1 lb. 50 per cent. Ovotran and 6 fl. oz. Systox, applied on 7th August or on 7th and 16th August, of *T. bimaculatus*. A 50 per cent. Aramite emulsion concentrate at 6 fl. oz., which was relatively ineffective against *P. pilosus*, 3 lb. 40 per cent. wettable p-chlorophenyl phenyl sulphone, 8 or 16 fl. oz. 25 per cent. emulsion concentrates of di(p-chlorophenyl)-ethoxymethyl-carbinol and 4, 4′-dichlorobenzilicacid-ethyl ester all gave good control of *T. bimaculatus*. The fungicide, 2-heptadecyl glyoxalidine acetate, at 32 fl. oz. 24 per cent. liquid concentrate, gave fairly good control of *P. pilosus*, but was ineffective against *T. bimaculatus* ; hydrated lime was not included in this

spray, which may account for the slight leaf injury caused. The 2,4-dichlorophenyl benzenesulphonate caused leaf drop and fruit spotting and affected the flavour of the fruit after one application. The addition of charcoal or lime as safeners for parathion [*cf.* **38** 494] temporarily reduced toxicity to *P. pilosus*, but had no adverse effect after ten days. DDD (TDE) [dichlorodiphenyldichloroethane], applied at 1–3 lb., caused 80–85 per cent. reduction in numbers of *T. bimaculatus* after nine days.

In tests against *B. praetiosa*, 8 fl. oz. Systox was more effective and 0·5 lb. 25 per cent. EPN less so than 1 lb. 15 per cent. parathion, and 1·5 lb. 50 per cent. Ovotran was less effective than Systox after three days but equal to it after 9–24 days.

MUKA (A. A.), GYRISCO (G. G.), HOPKINS (L.) & MARSHALL (D. S.). **Further Advances in Alfalfa Snout Beetle Control.**—*J. econ. Ent.* **45** no. 2 pp. 298–302, 4 refs. Menasha, Wis., 1952.

Further tests were made of organic insecticides for the control of *Otiorrhynchus* (*Brachyrrhinus*) *ligustici* (L.) on lucerne in northern New York in 1949–51 [*cf. R.A.E.*, A **38** 203]. When applied at about 1·5 lb. toxicant per acre in April 1949 or May 1950 as mists by a thermal-aerosol machine at its largest particle-size setting, BHC (benzene hexachloride), toxaphene, aldrin [1,2,3,4,10,10 - hexachloro - 1,4,4a,5,8,8a - hexahydro - 1,4,5,8 - diendo - methanonaphthalene] and dieldrin [1,2,3,4,10,10 - hexachloro - 6,7 - epoxy - 1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] in oil solutions and BHC, chlordan, aldrin and dieldrin in water suspensions all gave good control of adults at distances of up to 10–20 ft. from the nozzle. Oil solutions were slightly more effective than water suspensions, but not enough to justify the extra cost. Such treatments proved very effective for rapid control of small infestations, even under adverse soil and atmospheric conditions.

When applied as dusts, dieldrin, aldrin, chlordan, BHC and parathion at 1·25 lb. toxicant per acre and toxaphene at 2·5 lb. were all at least as effective as the standard bait [*loc. cit.*] in April 1949, and dieldrin, aldrin, lindane [at least 99 per cent. γ BHC], chlordan, toxaphene and parathion at 1 lb. per acre in May 1950 or May 1951 were all effective. In emulsion sprays applied at 5 U.S. gals. per acre, dieldrin, aldrin, chlordan, BHC, lindane or parathion at 1 lb. toxicant per acre in May 1950 or May 1951 gave good control, drifted less than dusts and were less unpleasant to apply.

Tests with baits in 1950 showed that aldrin, dieldrin or chlordan at 1 or 2 lb. per acre were as effective as 8 lb. sodium fluosilicate in the standard bait, with or without formalin, and remained toxic for longer ; lower concentrations might be equally effective. The organic compounds acted as both contact and stomach poisons and had no repellent effect, and storage of baits containing formalin for a week did not affect their toxicity or attractiveness.

By all methods of treatment, there was little to choose between the various organic materials, dieldrin being not significantly better than the others, and toxaphene, the poorest, giving good commercial control.

ASHDOWN (D.) & CORDNER (H. B.). **Some Effects on Insect Control and Plant Response of a systemic Insecticide applied as a Spray, a Seed Treatment, or a Soil Treatment.**—*J. econ. Ent.* **45** no. 2 pp. 302–307, 5 refs. Menasha, Wis., 1952.

An account is given of field investigations in Oklahoma on the effects of a systemic insecticide referred to as a diethoxythiophosphoric acid ester of 2-ethyl mercaptoethanol [the trialkyl thiophosphate, O-(2-(ethylmercapto)

ethyl) O,O-diethyl thiophosphate] on the growth and infestation by insects of peas and egg-plant [*Solanum melongena*].

In tests against *Macrosiphum pisum* Harris (*pisi* (Kalt.)) on peas [*cf. R.A.E.* A **39** 385 ; **40** 82], a material consisting of 50 per cent. of the ester on activated charcoal was applied to moistened seed at the rate of 8 oz. per 100 lb. or to soil at the bottoms and sides of the furrows at 12 gm., mixed with sand, per 36 ft. of row at sowing time, and a spray prepared by diluting 7·1 cc. of an emulsion concentrate containing 32·1 per cent. of the ester [Systox (*cf.* **40** 124)] in 8 U.S. quarts water was applied to the foliage at 1 U.S. quart per 36 ft. of row on 14th April, 40 days after sowing. The seed was sown at 1 lb. per 100 ft. of row, and some plants received both seed and spray treatment. Neither seed nor soil treatment affected germination, but by 14th April, the soil treatment had significantly retarded growth, which was not affected by Aphid attack. By 27th April, untreated plants showed highly significant retardation of growth, there was less but significant retardation on plants that had received the spray treatment alone, and plants in treated soil had made up the earlier deficiency in growth. Aphid counts at intervals until 4th May showed that almost complete control was obtained when the toxicant was applied to the seed or the soil and that spray applications reduced high populations, until only small colonies remained on the lower sides of older leaves near the ground, and rendered later plant growth toxic. All the Aphids found on the plots given seed or soil treatment were winged females, and none reproduced on the treated plants. Later observations showed that plants in treated soil remained almost free from Aphids until harvest (23rd–28th May), those from treated seed occasionally became infested by colonies of 2–4 young nymphs or wingless adults and sprayed plants had small infestations of immature and adult Aphids. Yields showed consistent and very significant increases from all treatments, and plants receiving soil or seed treatment gave significantly greater yields of early-maturing peas, as shown by size and analyses of solids and sugars, than those receiving only the spray or no treatment. Residue analyses showed only traces of toxicant in the shelled peas for all but the soil treatment, which resulted in residues of 1·6 parts per million.

Egg-plant seedlings were transplanted on 3rd May into holes in the soil into which 2·5, 1, 0·5 or 0·2 gm. of the charcoal mixture, diluted with sand, had been poured. The highest dosage was not markedly phytotoxic, though some wilting was noted in the first two weeks, and height and weight of plants and yield all increased consistently with increased dosage. The untreated plants and those receiving 0·2 gm. showed consistently more injury by flea-beetles (*Epitrix cucumeris* (Harr.) and *E. fuscula* Crotch) and the Tingid, *Gargaphia solani* Heid., than the others, and only those receiving 2·5 gm. were uninjured by *G. solani*. No treatment had any apparent effect on the adults or larvae of *Leptinotarsa decemlineata* (Say). Plants treated with 2·5 gm. produced four times as much fruit as untreated ones, and those treated with 0·2 gm. twice as much, in spite of the fact that this dosage did not give adequate protection against the flea-beetles or the Tingid.

KEH (B.). **Mating Experiments with the Two-spotted Spider Mite Complex.**—*J. econ. Ent.* **45** no. 2 pp. 308–312, 6 refs. Menasha, Wis., 1952.

Females of the Tetranychid described by McGregor in 1950 as *Tetranychus multisetis*, which are carmine in colour, differ from carmine females of *T. bimaculatus* Harvey only in possessing additional setae on the fore tibia and tarsus ; *multisetis* is distributed in the south of the United States, whereas *T. bimaculatus* occurs primarily in the more northern temperate zone. Davis in 1950 found that males of *multisetis* interbred readily with carmine females of *T. bimaculatus*, and their progeny were fertile. Experiments in which adults

of *multisetis* were crossed with green adults of *T. bimaculatus* were therefore carried out in an attempt to clarify the taxonomic status of *multisetis*. The following is based on the author's summary of the results.

Males of each form paired readily with females of the other. An F_1 generation was frequently produced, and subsequent inbred generations were obtained in some cases. In 23 crosses of *multisetis* females with *bimaculatus* males, the female progeny resembled the original females in setation and colour to the F_4 generation, when this was attained ; the fertility of the F_1 females was markedly less than that of the original females and varied in individuals from complete sterility to low fertility. In 36 crosses of *bimaculatus* females with *multisetis* males, the female progeny to the F_3 generation also resembled the original females in setation, and there was a similar decline in fertility. The F_1 females were of a carmine colour typical of *multisetis*, but the F_2 generation showed both green and carmine coloration, with green females predominating, and some females changed from green to carmine after 5–6 days. No decline in fertility was noted in the stock colonies of either *T. bimaculatus* or *multisetis*.

It is concluded from these results and the difference in geographical distribution that *multisetis* is a subspecies of *T. bimaculatus*.

BURRAGE (R. H.) & GYRISCO (G. G.). **Control of the European Chafer in Pasture Sod.**—*J. econ. Ent.* **45** no. 2 pp. 313–315, 1 ref. Menasha, Wis., 1952.

In parts of New York State, permanent pasture is fairly continuously infested by larvae of *Amphimallon majalis* (Razoum.), which cause serious reduction in yield during the grazing season [*cf. R.A.E.*, A **35** 250], and soil applications of parathion, dieldrin [1,2,3,4,10,10 - hexachloro - 6,7 - epoxy - 1,4,4a,5,6,7,8,8a - octahydro - 1,4,5,8 - diendomethanonaphthalene], aldrin [1,2,3,4,10,10 - hexachloro - 1,4,4a,5,8,8a - hexahydro - 1,4,5,8 - diendomethano - naphthalene], chlordan, BHC (benzene hexachloride) and DDT in diluted dusts, made with a hand-operated fertiliser spreader on 25th September 1949 or 17th April 1950, were tested for their control. Autumn applications after the livestock have been removed from the pasture for the winter involve little danger of their being poisoned by insecticide residues, and are considered the more practicable, but the spring applications were made to determine whether treatment at that time would prove effective.

Highly significant reductions in larval populations were given by parathion at 5 lb., dieldrin at 1 lb. and BHC at 1 lb. γ isomer per acre two months after the autumn application, by parathion and aldrin at 1 lb., γ BHC at 0·5 lb. and DDT at 5 lb. eight months after it, and by dieldrin and aldrin at 1 lb., γ BHC at 2 lb. and DDT at 5 lb. in October 1951 when these materials had effectively controlled the larvae of three generations. Chlordan at 5 lb. per acre was ineffective, and BHC is considered less suitable for use than dieldrin, aldrin or DDT as it might affect the taste of food crops grown on a treated area.

Five weeks after the spring application, parathion and dieldrin at 5 lb. per acre had caused significant reductions, but 5 lb. aldrin or chlordan, 2 lb. γ BHC and 15 lb. DDT had had no effect.

HERRON (J. C.). **Control of Sweet Clover Weevil in Ohio.**—*J. econ. Ent.* **45** no. 2 pp. 316–319, 7 refs. Menasha, Wis., 1952.

Investigations on methods of protecting seedlings of sweet clover [*Melilotus*] from *Sitona cylindricollis* Fhs. in Ohio in 1950 and 1951 showed that when sweet-clover stands were not ploughed under for green manure until after the middle of May, by which time 85 per cent. of the total oviposition by the

overwintered generation had occurred, and the ground was prepared immediately for maize, most of the new generation was destroyed in the egg or larval stage. This practice had little or no effect in reducing the older generation, but sweet clover sown in early spring was generally sufficiently developed by mid-May to overcome the defoliation caused by the increased population of adults migrating from the ploughed fields. Varieties producing spring foliage earliest and in greatest quantity appeared least damaged by the weevil, but no variety was immune. Delaying sowing from 22nd April until 20th May reduced feeding injury from 86·6 to 20 per cent., but the late-sown plants were of poor quality owing to adverse weather.

Insecticides were tested for control of the adults on newly sown sweet clover in both years. In 1950, the seed was sown on 20th April, and 1 per cent. dusts were applied as a top dressing to the soil, BHC (benzene hexachloride) at a rate giving 1·25 lb. γ isomer and other compounds at 5 lb. per acre, when most of the plants were through the soil or a week later. On both dates of application, heptachlor [1 (or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endo-methanoindene] was the most effective insecticide tested and methoxy-DDT (methoxychlor) the least, and DDT was less effective than chlordan and BHC, which did not differ significantly from each other. In 1951, sweet clover of white and yellow varieties was sown on 25th April and treated on 3rd–5th May. The stand of the white variety was poor, owing to bad weather, so that it did not attract many weevils, and only the results on the yellow variety are considered valid. BHC was not used for fear of toxic residues in the soil, and methoxy-DDT because it was relatively ineffective. When applied at 5 lb. per acre, heptachlor gave almost complete protection, chlordan and aldrin 81·8 and 88·5 per cent. reduction in injury and DDT 46·9 per cent., in spite of heavy wind and rain immediately after treatment. At 3 lb., aldrin was very effective (86·7 per cent. reduction in injury) and the effectiveness of DDT was little altered, but that of heptachlor and chlordan was materially reduced. At 1 lb. per acre, only aldrin was effective (68·4 per cent. reduction in injury). Examination in May 1951 of the plots treated in 1950 showed that no treatment had prevented the establishment of larvae or caused any reduction in their density.

Chiang (H. C.) & Hodson (A. C.). **Relation between Egg Mass Abundance and Fall Populations of First-generation Corn Borer and Justification for Insecticidal Control in Field Corn.**—*J. econ. Ent.* **45** no. 2 pp. 320–323, 2 graphs, 3 refs. Menasha, Wis., 1952.

The following is based largely on the authors' summary. Field observations on the first generation of the corn borer [*Pyrausta nubilalis* (Hb.)] on field maize in Minnesota in 1948–51 showed that irrespective of the presence or absence of a definite and prominent peak in egg deposition in early summer, the greatest number of egg masses found per 100 plants on any one day during the oviposition period was directly proportional to the total number for the entire period, so that the use of the former record as an index of the latter appears to be biologically sound. There was a trend towards a direct proportion between the highest number of egg masses found per 100 plants on any one day during the oviposition period and the number of first-generation larvae and pupal cases found in autumn. It is shown that the current method of estimating the loss in yield as 3 per cent. for each borer of the first generation per plant in autumn [*cf. R.A.E.*, A **31** 254] is not necessarily valid for all varieties of maize or for all conditions of infestation in a two-generation area, but that where it is satisfactory, it will be possible to estimate the loss in yield in early summer from the highest number of egg masses. Calculations indicate that insecticidal treatment of an infestation with a maximum egg-mass count of

50 per 100 plants might bring little return, but careful consideration is necessary of such factors as the variation in the relation between egg-mass counts and losses in yield, the cost of treatment, the degree of control to be expected, the normal yield of the land, the value of the crop and the complication of infestation by borers of the second generation.

CORKINS (J. P.) & METCALF (H. N.). **Greenhouse Tests of a Trialkyl Thiophosphate Insecticide.**—*J. econ. Ent.* **45** no. 2 pp. 326–329, 2 refs. Menasha, Wis., 1952.

In greenhouse tests in Montana, the systemic insecticide, Systox (containing 32·1 per cent. of a trialkyl thiophosphate [O-(2-(ethylmercapto)ethyl) O,O-diethyl thiophosphate]), applied in a water-emulsion spray containing 0·13 per cent. active ingredient at a pressure of 40–60 lb. per sq. in. to all exposed plant surfaces to the point of run-off gave promising control of *Planococcus* (*Pseudococcus*) *citri* (Risso), *Trialeurodes vaporariorum* (Westw.) and *Tetranychus bimaculatus* Harvey on various flowering plants, with no apparent phytotoxic effect except on violet (infested by the mite only), on which slight injury was suspected after five days but had disappeared after 22 days. When 4·8 gm. toxicant was added to the irrigation water applied over four days to a *Saintpaulia* plant growing in a pot containing about 83 cu. ins. soil it gave 78 per cent. control of *P. citri* immediately and 100 per cent. in about a fortnight, but caused severe damage to the plant, which, however, had recovered after two months.

Numerous greenhouse plants were sprayed with 0·3 per cent. of the toxicant and again with 0·09 per cent. 37 days later. The greenhouse was closed for a day and a half after the first application, which caused abnormally high tempertures. Heavy infestations of *P. citri* were completely controlled 16 days after the first application on single trees of *Citrus* and *Ficus lyrata* and almost controlled on *Passiflora*, which, however, still showed an occasional mealybug 38 days after the second application. A heavy infestation of *Myzus persicae* (Sulz.) on *Hydrangea macrophylla* was completely controlled 16 days after the first spray. This damaged plants of about 15 species, but the second was less injurious and affected only four species. Lists are given of the plants affected and of 66 species that were apparently unaffected by either application.

JENSEN (D. D.), FRAZIER (N. W.) & THOMAS (H. E.). **Insect Transmission of Yellow Leaf Roll Virus of Peach.**—*J. econ. Ent.* **45** no. 2 pp. 335–337, 10 refs. Menasha, Wis., 1952.

The virus disease of peach referred to as yellow-leaf roll was discovered in 1950 in a restricted area in California in which Western X-disease of peach, which is transmitted by *Colladonus geminatus* (Van D.) [*cf. R.A.E.*, A **39** 399], also occurs. Its symptoms somewhat resemble those of the latter, though there are important differences, but it affects the trees more severely and spreads more rapidly. *C. geminatus* is common in stone-fruit orchards in California and readily completes its life-cycle on peach. Its ability to transmit the virus of yellow leaf-roll was therefore investigated.

The test insects were reared in the greenhouse on celery or peach, allowed to feed on infected peach seedlings for 5–34 days and then transferred to healthy ones, on which they were left for 7–90 days. Signs of the disease appeared on the latter between six weeks and four months after exposure to the infective insects, depending on the rate of plant growth. The Jassid transmitted the virus in 19 of 32 tests in which 5–20 nymphs and adults were used per plant, and in five of six with 20 nymphs per plant. There was a latent period in the vector that appeared to last about 34 days or more, and the virus

was retained indefinitely and transmitted to several successive plants. *C. montanus* (Van D.), which is more abundant than *C. geminatus* in the affected area, was not tested adequately as a vector, but no transmission was effected by Fulgorids, Membracids or Jassids of 14 genera other than *Colladonus*. Since yellow leaf-roll and Western X-disease show some similarity of symptoms and have at least one common vector, it is suggested that the causal viruses are closely related.

C. geminatus also transmits the virus of California aster yellows [*cf.* **39** 446], and the main vector of this, *Macrosteles divisus* (Uhl.), is common in the area affected by yellow leaf-roll, but aster yellows was not transmitted from aster to peach by *M. divisus* or from celery to peach by *C. geminatus*.

Smith (F. F.). **Conversion of Per-Acre Dosages of Soil Insecticide to Equivalents for small Units.**—*J. econ. Ent.* **45** no. 2 pp. 339–340, 5 refs. Menasha, Wis., 1952.

In laboratory and greenhouse experiments with soil insecticides, dosages per acre have been converted to dosages per square foot of surface, or per weight of air-dried soil from an estimate of the weight of an acre of air-dried soil to plough depth (6–6·66 ins.). The author points out, however, that the roots of plants growing in pots usually penetrate to all parts of the container in a few weeks, so that the plants utilise all the soil. They therefore thrive for longer, and the plant injury and insect mortality resulting from doses of insecticide based on surface area are less, in deep than in shallow pots. Furthermore, air-dried soils vary considerably in specific gravity. He therefore considers that chemicals should be applied at dosages based on soil volume, with soil type and other pertinent characteristics taken into consideration, and gives a table showing the equivalents in mg. for various standard volumes of soil of a dosage of 1 lb. per acre to a depth of 6 ins. In any experiment, pots should be selected for uniformity, and tables for determining dosages should be drawn up on the basis of their content of soil when ordinarily filled for growing plants.

Frick (K. E.). **The Value of some Organic Phosphate Insecticides in Control of Grape Mealybug.**—*J. econ. Ent.* **45** no. 2 pp. 340–341, 1 ref. Menasha, Wis., 1952.

Pseudococcus maritimus (Ehrh.) became abundant in some vineyards in the lower Yakima Valley, Washington, in the summer of 1950. Small infestations had probably been present for some years, and the use of 5 per cent. DDT dust against *Erythroneura comes* (Say) could not have been the sole cause of the sudden increase since undusted vineyards were also affected. In August, the grapes were heavily coated with honeydew, and the adult females had migrated to the trunks and main laterals where they oviposited under loose bark. The eggs soon hatched, and the crawlers overwintered under the bark, giving rise to adults in the following May or June. Crawlers were found in groups under loose bark by 5th July and were dispersing over the vines by 18th. Most were a quarter grown and there were small amounts of honeydew on grapes on 26th July. Control measures were delayed because of the lateness of the flowering season, but were applied on 27th July, when vines were soaked from both sides with sprays applied at a pressure of 500 lb. per sq. in. or dusted from both sides at 50 lb. per acre. A spray of 1 lb. 25 per cent. wettable parathion per 100 U.S. gals. gave complete control for the rest of the season and one of 1 lb. malathon (S-(1,2-dicarbethoxyethyl) O O dimethyl dithiophosphate) gave good initial control but was less effective later and was the only treatment that permitted an increase in honeydew on the grapes by 13th September. A spray

of 1 lb. 27 per cent. wettable EPN (ethyl p-nitrophenyl benzenethiophosphonate) per 100 U.S. gals. and a 2 per cent. parathion dust were the least effective. They gave relatively poor initial control, but kept infestation moderately low throughout the season. There was a greater, though gradually decreasing, number of bunches showing honeydew after these than after the other treatments. Counts of the numbers of batches of unhatched eggs under strips of bark on groups of 12 vines 69 days after treatment showed none for the parathion spray, 19, 25 and 39 for EPN and malathon sprays and the parathion dust, respectively, and 238 for no treatment.

The temperature was 95°F. at the time of application, and maximum temperatures of 91–96° prevailed for the following nine days, but there was no visible damage to plant or fruit from any of the materials used. The odour of malathon was strong for 14 days after application and faint for four days more; no odour was noticeable in the parathion rows seven days after application.

Doutt (R. L.). **Biological Control of** *Planococcus citri* **on commercial Greenhouse** *Stephanotis*.—*J. econ. Ent.* **45** no. 2 pp. 343–344, 2 refs. Menasha, Wis., 1952.

The experiment described was carried out in 1951 in a commercial greenhouse in California that was left open and unheated in December, but closed and kept at a temperature that seldom dropped below 70°F. from January onwards. Beginning in January, when 66 per cent. of the *Stephanotis* plants were heavily infested by *Planococcus citri* (Risso), 600 examples of the predacious Coccinellid, *Cryptolaemus montrouzieri* Muls., which has a threshold of activity of 70°, and 19,360 of the parasitic Encyrtid, *Leptomastix dactylopii* How., which appears to prefer a warm, humid environment, were released in the greenhouse, and by April only 1 per cent. of the plants were infested. Scarcely any mealybugs were found on the 528 plants in the next four months, and the natural enemies gradually disappeared, though adults of *Cryptolaemus* maintained themselves for a time on immature stages of *Saissetia coffeae* (Wlk.) (*hemisphaerica* (Targ.)). The light infestation of this scale was reduced by these and by the activity of another Encyrtid, *Metaphycus helvolus* (Comp.). In September, a few mealybugs were found, and infestation increased slightly in October, but remained well below economic levels.

Brett (C. H.) & Eitel (W. J.). **Comparison of Dieldrin and Aldrin with other Compounds as Grasshopper Toxins.**—*J. econ. Ent.* **45** no. 2 pp. 346–347, 1 ref. Menasha, Wis., 1952.

The results are given of laboratory tests in Oklahoma against nymphs and adults of *Melanoplus* spp., mainly *M. differentialis* (Thos.), in which heptachlor [1 (or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene], EPN (ethyl p-nitrophenyl benzenethiophosphonate) and Compound 1189 (2,3,3a,4,5,6,7,7a,8,8-decachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindenol-1) were compared as stomach and contact poisons with aldrin [1,2,3,4,10,10 - hexachloro - 1,4,4a,5,8,8a - hexahydro - 1,4,5,8 - diendomethano - naphthalene] and dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene], which are known to give good control in the field when used at the rate of about 0·25 lb. per acre. As a few of the cultures contained parasitised individuals, control was determined by Abbotts' formula [*R.A.E.*, A **13** 331].

In tests of stomach action, the lowest concentrations that gave 100 per cent. control were 0·03 per cent. for aldrin and dieldrin and 0·25 per cent. for the

other three materials, whereas in tests of contact action, 0·5 per cent. dieldrin gave 100 per cent. control, 0·5 and 1 per cent. aldrin 95 and 100 per cent., 0·5 and 1 per cent. heptachlor 75 and 100 per cent., and 0·5 and 1 per cent. EPN 75 and 94 per cent., while 0·25, 0·5 and 1 per cent. Compound 1189 gave 0, 0 and 22 per cent. Tests with lower concentrations of EPN indicated that this material soon loses its effectiveness, being apparently dissipated before the grasshoppers have time to consume a lethal quantity.

It is concluded that heptachlor is comparable in effect with aldrin and dieldrin, but that EPN and Compound 1189 would probably give erratic results in the field, depending on the degree of grasshopper feeding at the time of application.

Polivka (J. B.). **Control of the Northern Masked Chafer with Aldrin and Dieldrin.**—*J. econ. Ent.* **45** no. 2 pp. 347–348, 1 ref. Menasha, Wis., 1952.

Injury to turf by *Cyclocephala borealis* Arr. has been increasing in north-eastern Ohio in the last few years [*cf. R.A.E.*, A **39** 21] and is aggravated by birds, moles and skunks that tear up the turf to feed on the larvae. Experiments on control were carried out in 1951 on a golf course at Wooster. Dusts of aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-di-endomethanonaphthalene] and dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] were applied in early March at 1–80 lb. technical material per acre, and washed into the soil by rain soon after, and larvae were counted in soil samples taken to a depth of 8 ins. in late May or early June, before adult emergence, and again in late September, before larvae of the next generation had begun their downward movement. Larvae were practically eliminated by September and there was some reduction, which was significant for all but dieldrin at the lowest rate, in May or June, though populations at that time were still high enough to cause damage. Birds caused no damage to the treated plots but tore up a considerable amount of turf in adjacent untreated areas. None of the treatments caused noticeable injury to the grass.

MacCreary (D.) & Milliron (H. E.). **Occurrence of the Smartweed Borer and the European Corn Borer in Apples.**—*J. econ. Ent.* **45** no. 2 p. 348, 4 refs. Menasha, Wis., 1952.

In the course of spray tests in an apple orchard in Delaware in 1951, 0·5 per cent. of the picked and 19·5 per cent. of the dropped fruits were found in September to be infested by half- to full-grown borers resembling *Pyrausta nubilalis* (Hb.), and 90 larvae of *P. ainsliei* Heinr. and 40 of *P. nubilalis* were subsequently collected from dropped apples of one variety and nine of *P. nubilalis* from those of another in the neighbourhood. A few borers were found as high as 7 ft. above the ground in unharvested apples.

The borers had evidently migrated from recently mown vegetation forming the ground cover, and a survey of the principal plants growing under the trees showed that *Polygonum pennsylvanicum*, *Chenopodium album* and *Phytolacca decandra* were infested by *Pyrausta ainsliei*, and *Amarantus hybridus* and *Panicum dichotomiflorum* by both species, *Pyrausta ainsliei* greatly predominating. The considerable number of larvae found dead in their tunnels suggests that apples are unsuitable for the growth and development of these two species.

CHOLLET (C. C.) & BREAKEY (E. P.). **Control of Aphids and Mites on Hops by organic Phosphate Insecticides.**—*J. econ. Ent.* **45** no. 2 p. 349. Menasha, Wis., 1952.

The toxicity of certain organic phosphorus insecticides to *Phorodon humuli* (Schr.) and an undescribed species of *Septanychus* on hops was tested in Washington State in 1951. Parathion was used as a wettable powder, and the other materials as emulsion concentrates. Sprays containing 20 oz. 25 per cent. parathion, 16 oz. 60 per cent. schradan (bisdimethylaminophosphonous anhydride), 20 oz. Systox (32·1 per cent. trialkyl thiophosphate [O-(2-(ethylmercapto)ethyl) O,O-diethyl thiophosphate]), 10 oz. Potasan (30·6 per cent. diethoxythiophosphoric acid ester of 7-hydroxy-4-methyl coumarin) or 20 oz. 50·3 per cent. malathon (S-(1,2-dicarbethoxyethyl) O,O-dimethyl dithiophosphate) per 100 U.S. gals. were applied at about 1 U.S. quart per plant on 18th or 19th July, when the Aphid was well established and mite populations light but increasing. Counts on the lower leaf surfaces on 25th July and 1st and 16th August showed that all the compounds gave practically complete control of the Aphid on all three dates and good but decreasing control of the mite. The last mite count showed considerably lower populations on plants treated with schradan and Potosan than on the others, but it is not known whether the differences were significant.

BROOK (T. S.) & DAHM (P. A.). **The Toxicity of Aldrin, Dieldrin, and DDT to the Large Milkweed Bug.**—*J. econ. Ent.* **45** no. 2 pp. 349–350, 3 refs. Menasha, Wis., 1952.

Acetone solutions of six concentrations each of p,p′DDT and recrystallised aldrin [1,2,3,4,10,10 - hexachloro - 1,4,4a,5,8,8a - hexahydro - 1,4,5,8 - diendo - methanonaphthalene] and dieldrin [1,2,3,4,10,10 - hexachloro - 6,7 - epoxy - 1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] were injected into adult females of *Oncopeltus fasciatus* (Dall.) that had emerged 9–11 days before, at the rate of 2 cu. mm. solution per 0·1 gm. insect tissue, and the numbers dead and moribund after 24 and 48 hours were compared with those for similar females treated with acetone only. Milkweed seeds and water were provided during the observation period. Three replicates of 100 insects were used for each concentration of each compound, and the dosages causing 50 and 95 per cent. mortality after 24 and 48 hours were calculated from the regression equations derived from the average mortalities of the three replications.

The median lethal dosages of DDT, aldrin and dieldrin were 31, 4·5 and 6·9 mmg. per gm. bodyweight after 24 hours and 11, 2·4 and 3·8 after 48, and the doses causing 95 per cent. mortality were 1,043, 72 and 61 mmg. per gm. after 24 hours and 437, 43 and 39 after 48, aldrin proving about 5–15 times and dieldrin 3–17 times as toxic as DDT.

MAYNARD (E. A.). **A Monograph of the Collembola or Springtail Insects of New York State.**—9½×6¼ ins., xxii [+1]+339 pp., col. frontis., 37 pls. (4 col.), 4 figs., 39 pp. refs. Ithaca, N.Y., Comstock Publ. Co., Inc.; London, Constable & Co., Ltd., 1951. Price 60*s*.

This book consists of two parts, of which the first (pp. 1–19) contains information on the phylogeny, morphology and anatomy, bionomics, distribution, economic importance, and nomenclature of Collembola, with methods for their collection and preservation, and the second (pp. 20–288) comprises a systematic account of those known from New York State, with which a few related forms from other areas are included. Keys are given to the various major divisions

and to the genera and species, with descriptions and notes on synonymy and on the distribution in New York and elsewhere, habitats, abundance and economic importance (where known) of the species. Four of the genera and upwards of 50 of the 206 species and forms dealt with are new. An extensive bibliography of the world literature relating to Collembola is appended.

PETERSON (A.). **Larvae of Insects. An Introduction to Nearctic Species. Part II. Coleoptera, Diptera, Neuroptera, Siphonaptera, Mecoptera, Trichoptera.**—$11 \times 8\frac{1}{2}$ ins., v+ 416 pp., 104 pls., many refs., multigraph. Columbus, Ohio St. Univ. [the Author], 1951. Price $7.

This concluding part of a work on the identification of Nearctic holometabolous insects is constructed on the same lines as the first [*R.A.E.*, A **37** 163] and enables larvae of the orders of agricultural importance dealt with to be identified to families.

BROWN (A. W. A.). **Insect Control by Chemicals.**—$8\frac{1}{2} \times 5\frac{1}{2}$ ins., vii+817 pp., 101 figs., many refs. New York, N.Y., J. Wiley & Sons, Inc. ; London, Chapman & Hall, Ltd., 1951. Price $12.50 or £5.

The subjects of this comprehensive review of the properties and uses of insecticides, with (in brackets) the space devoted to each, comprise : the chemical and physical properties of the insecticides in current use, classified as chlorinated hydrocarbons, organic phosphates, other synthetic organic compounds, botanicals, inorganic compounds and fumigants, and of the materials, such as solvents and dust diluents, that are used with them (62 pp.) ; the structure of organic chemicals and its relation to their toxicity to insects (107 pp.) ; the ways in which poisons can enter insects through the cuticle, respiratory system and digestive tract, and other factors that affect their toxicity and the relative susceptibility of different species and stages of insects to them (80 pp.) ; the modes of action of insecticides of various types (85 pp.) ; equipment for their application, and the physical factors that affect their dispersal (77 pp.) ; their application from aircraft (53 pp.) ; toxicity and hazards to man and domestic animals (64 pp.) and to plants (43 pp.) ; the ways in which chemicals have been used for the control of insects and mites that attack plants (94 pp.), and of other pests, including insects, mites and ticks injurious to man and livestock and pests of stored products (52 pp.) ; and the effects of insecticides on the balance of animal populations and the appearance of resistant strains of susceptible species (61 pp.).

Extensive bibliographies, to which constant references are made, are appended to the various sections.

LEPIGRE (A. L.). **Insectes du logis et du magasin. Lutte contre les insectes ennemis du commerçant et de la ménagère. Reconnaissance—moeurs et moyens de destruction.**—339 pp., 242 figs. Algiers, Insectarium, Jardin d'Essai, 1951.

This practical handbook on household pests and their control, which has been compiled with special reference to France and Algeria, deals with some 120 species or groups of insects and other arthropods, of which about three-quarters infest stored products, damage timber, furniture and fabrics, or are a nuisance in buildings [*cf.* also *R.A.E.*, B **40** 122]. Information on their appearance, habits, life-history and distribution and the damage they cause is given in one chapter, and four others are devoted to control. Of these, one deals with precautionary measures and the others with measures for the control of individual pests or groups of pests and the treatment of infested commodities and articles, and the preparation, properties and uses of the insecticides

recommended. An alphabetical list of the pests and the materials infested, with cross-references to the bionomics and relevant control measures, is given at the beginning of the book, and an appendix shows the nature and content of the toxic materials in a number of proprietary insecticides.

YASUMATSU (K.) & TACHIKAWA (T.). **Investigations on the Hymenopterous Parasites of** ***Ceroplastes rubens*** **Maskell in Japan.**—*J. Fac. Agric. Kyushu Univ.* **9** no. 2 pp. 99–120, 2 pls., 3 pp. refs. Fukuoka, 1949.

Ceroplastes rubens Mask. has spread over nearly all the provinces in Kyushu and Shikoku and the western half of Honshu since its introduction into Japan over 50 years ago and has become an important pest of *Citrus* and persimmon there [*cf. R.A.E.*, A **22** 524 ; **23** 405]. Attempts during 1932–38 to control it by the liberation of introduced parasites failed [*cf.* **31** 291], and a survey of native parasites at Nagasaki indicated that they exerted little control. In recent years, however, populations of *C. rubens* in northern Kyushu have shown a progressive decrease, and it was found in 1946 that whereas parasitism by *Microterys speciosus* Ishii and *Coccophagus hawaiiensis* Timb. in the Fukuoka Prefecture was low, that by *Anicetus annulatus* Timb., the third native species reared there, was relatively high. In further surveys at 36 places in the Fukuoka and Oita Prefectures of Kyushu in 1947, a total of 1,870 adults of this parasite was reared from *Ceroplastes rubens*, representing 97·04 per cent. of all the parasites obtained ; the other species were *Anabrolepis bifasciata* Ishii, *A. extranea* Timb., *Casca* sp., *Aphytis* sp., *M. okitsuensis* Comp., *M. speciosus* and *Coccophagus hawaiiensis*. The last two have been present for at least 20 years, during which their numbers have not increased, and none except *Aphytis*, which constituted 1·52 per cent., represented more than 0·59 per cent. of the total. In Oita Prefecture, which *Ceroplastes rubens* entered more recently than Fukuoka, *Anicetus annulatus* did not occur in appreciable numbers ; the percentage parasitism of *C. rubens* by Hymenopterous parasites was only 0·87 in one district there and averaged only 0·27 in another, whereas the average was 21·1 in Fukuoka. At Kyushu University, the parasitism percentages for *A. annulatus* varied from 25·4 to 49·1 on five closely planted trees of different species, whereas they were only 5·2–16·3 on a similar group of three trees of other species. The difference is attributed to the more open growth of the trees of the first group, which resemble *Citrus* in this respect, and the dense growth of sooty mould on those of the second, which appeared to cover the plants with black dust and was perhaps unfavourable to parasites [*cf.* **30** 196]. During the period under review, there was no appreciable mortality of *C. rubens* due to climatic factors or disease, but mortality caused by *A. annulatus* in Fukuoka was estimated at over 50 per cent. A list of the parasites is given, showing their distribution in Japan and elsewhere and their alternative hosts, and a table is appended showing all the known Hymenopterous parasites of the different species of *Ceroplastes*.

In 1947, adults of the eight parasites began to emerge in the field at the end of April and all except *A. annulatus* had completed emergence by the end of May ; under laboratory conditions, *A. annulatus* continued to emerge until 2nd July, with peak populations at the middle of June, when the two sexes were about equal in numbers. The ovipositing females of this species were unable to distinguish hosts that were already parasitised. Adults kept in glass tubes in the laboratory survived for an average of about four days without food and for about five when water was provided. With access to Aphid honeydew or diluted or concentrated honey, males survived for averages of 17·81, 18 and 21·42 days, respectively, and females for 20·64, 29·2 and 16·9 days. It is concluded that attempts should be made to distribute *A. annulatus* to areas in which *C. rubens* is inadequately controlled by parasites.

[KOSMACHEVSKIĬ (A. S.).] **Космачевский (А. С.). The Influence of Temperature and Humidity on the Rapidity of Development of Elaterids.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **73** no. 5 pp. 1101–1103, 5 refs. Moscow, 1950.

An account is given of observations on *Agriotes meticulosus* Cand., reared in the laboratory in Kazakhstan. Although the females oviposited without supplementary feeding, access to water was indispensable. Adults kept in a tumbler at 24–27°C. [75·2–80·6°F.] and 50–60 per cent. relative humidity lost weight in a few days without water, but regained it when water was provided. After nine days without water, mortality reached 90 per cent., as compared with only 10 per cent. in the constant presence of water.

The eggs of *A. meticulosus*, like those of Melolonthids [*cf. R.A.E.*, A **33** 160], survived only in the presence of capillary water, which they absorbed during the first 3–5 days of development. The sum of effective temperatures (above the threshold of 10°C. [50°F.]) necessary for egg development was 227 day-degrees C. [408·6°F.], and at mean temperatures of 23·3, 23·7 and 30°C. [73·94, 74·66 and 86°F.], it was completed in 17, 16 and 12 days, respectively.

The larvae, which were kept singly in washed sand in test-tubes and given germinating grains of wheat for food, passed through 15 instars. At mean temperatures of 20·3–27°C. [68·54–80·6°F.], the larval stage lasted about 250 days, the duration of the individual instars depending on nutrition and on soil temperature and humidity. The weight of the older larvae increased by 33–37 per cent. with each successive moult. During the periods before and after moulting, the larvae ceased feeding and became more susceptible to changes in environmental conditions. They absorbed water before moulting, and when deprived of it at this stage, they entered a state of diapause that lasted for up to 60–75 days. A diapause also occurred in larvae that fed on the endosperm of swollen wheat grains. Larvae that were not preparing to moult did not absorb water when placed in wet soil, which indicated an ability to regulate their water content. Moulting was delayed in soil with a low moisture content. The vertical migrations of the larvae in summer apparently lead to aggregations at sites with optimum humidity and aeration.

[YAKHIMOVICH (L. A.).] **Яхимович (Л. А.). Changes in the environmental Requirements of the Asiatic Locust during embryonic Development.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **73** no. 5 pp. 1105–1108, 8 refs. Moscow, 1950.

Investigations on the development of the eggs of *Locusta migratoria* (L.) were carried out in the laboratory in Moscow with a view to facilitating forecasts of the abundance of this locust in the Soviet Union. The development of the eggs is normally interrupted by a period of diapause, though cases of continuous development are recorded in the literature [*cf. R.A.E.*, A **19** 334]. The early period of development lasts 8–10 days in nature, and the diapause 8–9 months (autumn, winter and early spring), after which blastokinesis occurs and ultimately hatching. Both the early and the late periods of development were found to require high temperatures, being completed in minima of 6 and 9 days, respectively, at 30°C. [86°F.], but when eggs in diapause were kept at 30°C., only 1–2·5 per cent. of them had hatched at the end of three months. The others were exposed to temperatures of 0–6°C. [32–42·8°F.] for one month and then restored to 30°C., after which hatching occurred in 9 days. When diapausing eggs kept at 30°C. were transferred for one month to 5, 10 or 15°C. [41, 50 or 59°F.] and then returned to 30°C., 13, 80 and 100 per cent. resumed development in 5 days, hatching began in 20, 14 and 10 days, and 7, 33 and 100 per cent. hatched in 20 days. Keeping the eggs at low temperatures

immediately after deposition arrested their development, but did not reduce the period of diapause, a second exposure during diapause being necessary for this. These thermal requirements were the same for both the solitary and the gregarious phases of the locust. At a temperature of 30°C., eggs of the solitary phase entered diapause after 6 days and only 1·8 per cent. had hatched after 2–3 months, which disproves Plotnikov's statement that eggs of this phase develop without diapause [**15** 162].

During diapause, the eggs were not affected by excess or lack of contact water. Excess killed them before diapause, but was essential for the resumption of development after it. In experiments, eggs submerged in water developed normally until ready for hatching, provided that the temperature was suitable [*cf.* **28** 127] and there was sufficient oxygen in the water, but normal hatching was prevented and complete mortality ensued. The success of spring flooding as a control measure would, therefore, depend on the stage of embryonic development reached, the temperature and oxygen content of the water, and the duration [*cf.* **17** 261].

It is concluded that each of the three periods of development of the egg has special environmental requirements, so that they may be considered as distinct developmental stages. The diapause is not merely a cessation or retardation of development, but a definite stage in it, particularly as it is irreversible. Biologically, the diapause is probably an adaptation to existence in climates with severe winters, and this is confirmed by the absence of a diapause in the tropical race, *L. migratoria migratorioides* (R. & F.) [*cf.* **24** 229].

[VASIL'EV (K. A.).] **Васильев (К. А.). Migratory Flights of the Italian Locust** (*Calliptamus italicus* **L.**). [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **74** no. 2 pp. 385–388, 2 figs., 1 ref. Moscow, 1950. **Phases of the Italian Locust** (*Calliptamus italicus* **L.**). [*In Russian.*]—*T.c.* no. 3 pp. 639–642, 2 graphs, 5 refs.

In the second of these papers, the author gives an account of observations in 1945–49 in the Province of Karagandin (central Kazakhstan) on the behaviour of *Calliptamus italicus* (L.), carried out in view of reports suggesting that this locust, like some other Acridids, undergoes phase transformations. There was a mass outbreak of the species in 1945–47, when it was numerous in both the north and south of the Province, but it was abundant only in the hot south-west in 1948 and was sparse in the north, as a result of control measures and lower temperatures, which delayed development and reduced oviposition. In 1948, the behaviour of the locusts in the large aggregations in the south-west was very different from that of the sparse population in the north. In the former, the hoppers aggregated in dense bands that moved in an organised manner, swarms of winged individuals effected migratory flights over long distances, and the females oviposited in groups, but none of these characteristics was observed among the scattered locusts in the north, although they were the offspring of the typically gregarious individuals that had been abundant there in 1947 and were present on the oviposition sites of the latter.

The non-gregarious locusts also differed morphologically from the gregarious individuals, as was shown by their biometrical measurements, which are given in a table. In comparison with the gregarious locusts, the non-gregarious ones were smaller, their bodies and elytra being shorter, but the posterior femora were longer in the females, though shorter in the males. The most prominent difference was in the ratio of the length of the portion of the elytron projecting beyond the extended hind femur to the length of the elytron, which was 43·8 per cent. as great in non-gregarious as in gregarious individuals. This difference can be used to distinguish the two forms under field conditions.

It is concluded that *C. italicus* has two distinct phases, of which one is gregarious and has long wings and the other is non-gregarious (or solitary) and has short wings.

In the first paper, the author records concurrent observations on the flight of the gregarious phase. There were two kinds of flight, of which the first occurred at heights of up to about 33 ft. in sunny weather and was preparatory to the second, which occurred at about 164–654 ft. and was migratory in character. The low flight was observed 4–5 days after the adults had emerged and did not involve all individuals, some feeding with the remaining hoppers. It began at about 8 a.m., when the temperature at the soil surface reached 24–25°C. [75·2–77°F.] and was sporadic, longer and more frequent flights being undertaken as the temperature rose. The distances covered ranged up to a few hundred yards at a time, and the locusts sometimes moved in this way for some miles, but in general the range of low flight was restricted [*cf. R.A.E.*, A **24** 592]. It was not related to the direction of the wind and was apparently not connected with the search for food.

Migratory flights, which usually pass unnoticed owing to their height, were observed in bright sunlight through a cardboard tube 4 ins. long and 1 in. wide, which permitted the approximate density of swarms to be calculated. They occurred almost daily, except in rainy or very dull weather, and involved the whole of a given population, so that the breeding sites changed every year. The dates when migratory flights were first observed and their intensity varied in different years, depending on the rate of development. The flights began at about 1 p.m., reached a peak between 2 and 5 p.m. and finished at 6–7 p.m. They were not affected by temporary clouding of the sun, and were largely in the direction of the wind. If the wind was light or absent, the movements were disorderly and the locusts slowly circled in the air. Observations on the migratory flights of *C. italicus* facilitated the finding of subsequent foci of infestation, even at distances of some 40 miles from the initially infested sites, and as eggs in an advanced stage of development were found only in females that had completed migratory flights, they might be used to forecast the abundance of egg-pods.

BLUNCK (H.). **Zur Kenntnis des Massenwechsels von *Pieris brassicae* L. mit besonderer Berücksichtigung des Dürrejahres 1947.** [Contribution to the Knowledge of Fluctuation in Numbers of *P. brassicae*, with special Reference to the Drought Year 1947.]—*Z. angew. Ent.* **32** pt. 2 pp. 141–171, 5 figs., 5 refs. Berlin, 1950.

Investigations were made in 1942–47 in the Rhineland on the density of the adult population and the number of generations a year of *Pieris brassicae* (L.) and *P. rapae* (L.), by means of counts of adults in clover fields near Bad Godesberg and occasional observations on other plants, including cruciferous crops, there and in other localities. Both species normally had two generations a year, with a partial third under particularly favourable conditions, but the third was complete in the hot dry summer of 1947, and some of the pupae of this generation of *P. rapae* possibly gave rise to adults before the winter. The numbers of each species varied considerably with year and generation according to the efficacy of factors of natural control. These included various predators and the parasites, *Trichogramma evanescens* Westw., *Apanteles glomeratus* (L.) and *Pteromalus puparum* (L.), which attacked the eggs, larvae and pupae, respectively, of both species. Large numbers of eggs failed to hatch in 1947, probably because of the heat. The fungus, *Empusa* (*Entomophthora*) *sphaerosperma*, caused high mortality of larvae and pupae when wet weather

occurred in August and September, but was of no importance in 1947. Overwintering pupae of *Pieris brassicae* were very resistant to cold and suffered greater losses from natural enemies and disease than from unfavourable weather.

TISCHLER (W.). **Die Überwinterungsverhältnisse der landwirtschaftlichen Schädlinge.** [The Overwintering of Crop Pests.]—*Z. angew. Ent.* **32** pt. 2 pp. 184–194, 8 refs. Berlin, 1950.

In this review of the overwintering habits of insects and a few other invertebrate pests of crops in central Europe, the author points out that some species overwinter on or in the plants attacked, some overwinter in the soil in which the plants are or were grown and others do so in sites other than the cultivated area. The information on the third class is based on observations in northern Germany, and that on the first two is taken from the literature. Tables are given showing the class concerned, the overwintering sites and the stages in which winter is passed for pests of cereals and grassland, various vegetable crops, crucifers, leguminous plants, and fruits, and the general overwintering habits of various groups of pests and exceptions to them are briefly discussed. It is pointed out that two-thirds of the pests considered overwinter as larvae or adults.

SCHURR-MICHEL (E.). **Ein Bostrychide,** *Stephanopachys substriatus* **Payk. als Gerbrindenschädling.** [A Bostrychid, *S. substriatus*, as a Pest of Tanning Bark.]—*Z. angew. Ent.* **32** pt. 2 pp. 285–288, 6 figs., 9 refs. Berlin, 1950.

Spruce bark for use in tanning that had been stored in a silo for six years by a leather manufacturer in Thuringia was found to be heavily infested by *Stephanopachys substriatus* (Payk.). This Bostrychid is rare in Germany, where it occurs mainly in the eastern districts, and is known to attack dead and dying spruce trees. The literature on its distribution and bionomics is briefly reviewed. In April, adults, pupae and a few larvae were present, and some of the pupae were parasitised by an unidentified Chalcidoid of a genus close to *Rhopalicus*. The bark was mainly of local origin, but some of it came from Austria, and it is possible that the beetle was imported with it. It was much reduced in value by the infestation.

FIEDLER (O. G. H.). **Entomologisches aus Afrika (Beobachtungen über Kaffeeschädlinge).** [Entomological Notes from Africa (Observations on Coffee Pests).]—*Z. angew. Ent.* **32** pt. 2 pp. 289–306, 3 figs., 4 refs. Berlin, 1950.

This paper consists of four sections dealing with various insects that infest coffee in East Africa (Tanganyika and Kenya), based on the literature and observations by the author, mainly in the Kilimanjaro area. In the first, he discusses Coccids, of which *Coccus* (*Lecanium*) *viridis* (Green) and *Ferrisiana* (*Ferrisia*) *virgata* (Ckll.) (*Pseudococcus bicaudatus* Keuch.) are among the most important on coffee. Both are known to attack weak trees, but infestation was observed to spread quickly on young ones, particularly those exposed to the sun and protected from wind. *C. viridis* attacks the leaves, the tips of twigs, and the young wood on which the corky bark has not yet formed, and *F. virgata* forms colonies on the tips of young twigs and on veins at the base of the leaves. Isolated outbreaks of *Planococcus* (*Pseudococcus*) *kenyae* Le Pelley were also observed. This mealybug preferred the stalks of leaves or berries, and severe infestations resulted in poor growth and reduced yield. All three species are tended and distributed by ants, which protected them from many natural enemies, but not from the predacious larvae of the Noctuid, *Eublemma costimacula* (Saalm.), the habits of which are briefly described. *Icerya*

aegyptiaca (Dgl.) infested older trees under shade, but did not appear to cause serious damage.

An account is given in the second section of a method that has proved effective against larvae and pupae of the Lamiids, *Dirphya usambica* (Kolbe) and the more important *Anthores leuconotus* Pasc., in the stems. Extraction by means of wires was formerly practised [*cf. R.A.E.*, A **25** 357], but was slow and laborious and the trees were often severely damaged before the insects could be found. The new method consists in injecting Xylamon [*cf.* **25** 658–659] into the mines by means of a syringe, the entrances being sealed with clay to prevent the liquid running out. About 1 cc. should be introduced as far as possible into the mine. Treatment had no adverse effects on the trees, even if applied when they were bearing fruit, and gave good practical control.

Pests of the buds and flowers of coffee, reviewed in the third part, include *Antestia lineaticollis* (Stål) and *Antestia faceta* (Germ.) [*cf.* **40** 50], which are of little practical importance in this connection, and *Diarthrothrips coffeae* Williams, which causes sterility in the flowers and is particularly numerous in December–February. The Mirid, *Lygus coffeae* China, is a serious pest in some years, the adults piercing the buds and preventing them from opening. In addition, two unidentified Cecidomyiids were observed causing injury. The adults are briefly described, and notes are given on their bionomics. The eggs are laid in the buds, and the larvae feed on the internal organs, preventing normal opening. Pupation occurs on the ground under fallen leaves. Both preferred shady situations, and were responsible for losses of 20–30 per cent. of the buds in some plantations.

The status of the berry moth, *Thliptoceras octoguttale* (Feld.), on coffee is reviewed in the final section. It has been reported as a pest in Kenya [*cf.* **20** 117, 395], but was found by the author to be beneficial in many cases in Tanganyika, where infestation merely thins out the crop, thus enhancing subsequent yields.

Hendrix (N. J.). **De graanloopkever** (*Zabrus tenebrioides* **Goeze**). [The Corn Ground Beetle (*Z. tenebrioides*).]—*Tijdschr. PlZiekt.* **57** pt. 1 pp. 35–37, 1 pl. Wageningen, 1951.

Zabrus tenebrioides (Goeze) occurs in Holland only in South Limburg, where it is injurious mainly to rye and also to wheat and barley. The egg, larva and adult are briefly described. The eggs are laid in the soil in groups of 3–5 from the end of July to late autumn. The larvae hatch in 9–12 days and feed first on the roots of the seedlings and later on the young leaves. They pupate in the soil in May, and the adults emerge after 3–6 weeks and feed on the milk-ripe seeds of rye. They are attacked by various predators, a fungous disease, and the Tachinid parasite, *Viviania cinerea* (Fall.). Dusts of BHC (benzene hexachloride) hoed into the soil at rates giving about 3·5–4·5 lb. BHC per acre gave some control of the larvae when used in spring in fields of winter wheat or summer barley, but were ineffective even at 9 lb. per acre in rye fields, whether applied in spring or autumn. Damage is most severe where rye is grown on the same land in two successive years, and this practice should be avoided.

Loosjes (F. E.). **Enige proeven met bestrijdingsmiddelen tegen de larve van de lapsnuittor (=taxuskever), schadelijk aan cyclamenplanten.** [Control Experiments against *Otiorrhynchus sulcatus* injurious to Cyclamens.]—*Tijdschr. PlZiekt.* **57** pt. 1 pp. 38–42. Wageningen, 1951. (With a Summary in English.)

An account [illegible] given of preliminary experiments begun in Holland in 1949 to discover [illegible]factory treatment against larvae of *Otiorrhynchus sulcatus* (F.)

injuring cyclamen plants in pots. Immersing the pots for two hours in an emulsified solution of 0·2 per cent. technical DDT gave the best results. It had no harmful effect on the plants and caused complete mortality of larvae present at the time of treatment. Benzene hexachloride, chlordan and parathion gave inferior results, but in all cases emulsion dips were better than suspensions.

SPEYER (E. R.) & PARR (W. J.). **Animal Pests. I. Tomato Leaf-miner** (*Liriomyza solani*, **Hering**).—*35th Rep. exp. Res. Sta. Cheshunt 1949* pp. 48–56, 2 pls. Cheshunt, Herts., 1950.

Investigations on *Liriomyza solani* Hering on tomato in glasshouses were continued at Cheshunt during 1949 [*cf. R.A.E.*, A **40** 36, etc.]. In observations on its bionomics, adults were confined on seedlings 2–3 ins. high under lamp-glasses and provided with diluted syrup. The males fed only on the syrup, but the females fed principally on the sap from punctures made in the leaves with the ovipositor, though syrup was occasionally taken at mid-day when the temperature was high. Feeding pits were made on both surfaces of the cotyledons and secondary leaves, but were more numerous and more conspicuous on the upper surfaces [*cf. loc. cit.*]. Males paired about 24 hours after emergence, and females after a few hours. Females fertilised shortly after emerging oviposited 2–3 days later, but one fertilised on the day following emergence laid eggs after only a few hours. Females pair only once, but males are capable of doing so at least twice. Eggs were laid singly in pits that differed somewhat from the feeding pits, or occasionally in the latter. One female deposited 70 eggs on seven plants in 15 days, and three others laid totals of 40, 104 and 62. Apart from a few in the cotyledons, all the eggs were deposited in the three oldest leaves. Males with access to syrup survived for an average of five days, and fertilised females for 12. The sexes were about equal in numbers in the laboratory, but females were more than twice as numerous as males in the glasshouses.

The duration of the egg stage averaged six days at temperatures usual in glasshouses in which tomatos are raised, and most of the eggs were viable. The larvae normally mine in the leaves, but when many hatched within one leaflet, they tunnelled into the stalks and main stem. The first instar lasted about four days, and the fully fed third-instar larvae left the mines ten days after hatching. Development required about as long in heated glasshouses in February as in unheated ones in April–May. On leaving the mines, the larvae normally fall to the ground, which they entered to a depth of 0·25 in. to pupate, but pupation occurred rarely on the plants. The pupal stage lasted 36–65 days in puparia formed in February or early March, which were subjected to a temperature range of 44–99°F., and 17–22 days during April–May, when the range was 60–70°F. ; the mean temperature during both periods was about 64°F. Similar results were obtained from puparia collected in glasshouses, and it is concluded that larvae that become fully fed in February or, more probably, pupae that are formed then, undergo a period of diapause that does not occur later in the year. Similarly, most of the Hymenopterous parasite larvae [*cf. loc. cit.*] in puparia collected in February had not pupated 18 weeks later, though full-fed, whereas those in puparia collected in April–June gave rise to adults 16–30 days after the puparia were formed.

As a result of feeding by larvae in the cotyledons of seedlings prior to potting, the plants fail to develop normally and sometimes collapse ; injury by larvae mining in the secondary leaves and main stem of plants after potting is not severe, however, and of 25 plants in each of which 10–15 larvae completed their development (comparable to severe infestation early in the year), only 1–2 would not have recovered. The growth of three plants in which 4–16 larvae became full-fed between 21st February and 4th March was almost normal by 16th March, though the lowest two or three leaves had shrivelled.

In experiments on control by dusting the surface of the soil with DDT or BHC (benzene hexachloride) [*cf.* **40** 37], larvae were able to pupate and give rise to adults after penetrating soil dusted with 5 per cent. DDT, and six of ten larvae pupated after passing through soil dusted with BHC, though only three completed their development. Neither adults of *L. solani* nor the Hymenopterous parasites survived after emerging through soil dusted with BHC or DDT. A BHC dust containing 0·65 per cent. γ isomer applied to the leaves of infested seedlings destroyed the larvae and prevented subsequent mining, but injured the plants. In another experiment, an emulsified solution containing 0·01 per cent. γ BHC did not damage seedlings 0·75–5 ins. high in February, and no living larvae were found in mined leaves from plants in a nursery that had been sprayed three days earlier. When seedlings 1·5 or 3 ins. high were dipped in a solution containing 0·1 per cent. nicotine with a wetting agent, larvae mining in the leaves of the smaller seedlings were killed, but the older larvae in the larger plants survived and there was some scorching. Females released on some 70 seedlings, of which about half had been dusted with pyrethrum, fed only on the untreated plants and did not oviposit, and this treatment might afford some temporary protection. Few adults were attracted to sweetened baits in cage experiments and none in a propagating house in which they were abundant.

PITCHER (R. S.). **Observations on the Raspberry Cane Midge (*Thomasiniana theobaldi* Barnes) and its Association with Cane Blight.**—*35th Rep. E. Malling Res. Sta. 1947* pp. 141–143, 3 refs. East Malling, 1948.

In further investigations on the Cecidomyiid, *Thomasiniana theobaldi* Barnes, which is associated with cane blight of raspberry in England [*cf. R.A.E.*, A **32** 258 ; **33** 308], carried out at East Malling, Kent, in 1946–47, it was observed that eggs were deposited only in splits in the epidermis of the stem or in wounds caused by slugs or mechanical means. Females of the overwintered generation emerged in late April or early May and deposited up to 70 eggs each on the young green canes. The larvae fed under the epidermis and could be detected by the presence of superficial dark brown blotches. They pupated in the top half inch of soil. Adults of the first and second generations emerged in July and August, respectively, and there was probably a partial third. As there is considerable overlapping of generations, eggs and larvae are present from early May to mid-September.

Fructifications of various fungi were commonly found on the feeding areas a few weeks after the larvae had left them, whereas the surrounding cork tissue remained free from fungous attack. Two or three months later, both the cork and the underlying vascular tissues were usually dead and discoloured. Damage was confined to the tissues immediately below the sites of feeding, but these are so numerous on heavily infested canes that many die during the winter. Less severely damaged canes produce a few fruiting laterals, but die before they can bear fruit.

Serious attack is usually confined to a few susceptible varieties in which splits in the stems develop readily, and these may lose 75 per cent. of their canes. The application of fungicides has given poor control, possibly because the fungi are protected from sprays and dusts. Applications of tar oil or naphthalene to the soil did not give complete control of overwintering larvae of *T. theobaldi*, and DDT applied against the adults before the eggs were laid was too slow in action, the females laying the bulk of their eggs within a few hours of emerging. Turning over the soil gives some control of the pupae in summer, and turning furrows against the bases of the stools in winter buries some of them.